DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO 90/58

# SUMMARY OF SEISMIC INTERPRETATION IN THE EASTERN OFFICER BASIN

OIL, GAS AND COAL DIVISION

by

BRUNO THOMAS

OCTOBER, 1990

DME 409/88

F01629

CONTENTS PAGE



F01629

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO 90/58
DME NO 409/88
DISK NO F01629

# SUMMARY OF SEISMIC INTERPRETATION IN THE EASTERN OFFICER BASIN

## ABSTRACT

The Proterozoic tectonic evolution of the southern margin of the Eastern Officer Basin is closely related to evaporite mass movements and diapirism. Seismic interpretation suggests that these movements occurred when increased subsidence in the northern part of the basin (Munyarai Trough) induced the northward gravity sliding of the sedimentary cover upon evaporitic layers of the Alynia beds. The deposition of Proterozoic sediments ended with the cutting and infilling of deep erosional canyons. The Proterozoic evaporitic structures were further reactivated by gentle thrusting and folding during the Alice Springs Orogeny.

The hydrocarbon play concepts within the Proterozoic associated with evaporite movements are; tilted fault blocks resulting from the sliding of the cover, domal and fault dependent closures above or along the diapiric structures, and paleoreliefs inherited from the canyon cutting event.

## INTRODUCTION

The Officer Basin is an east-west arcuate depression extending from Western Australia to South Australia. The South Australian part of the basin is known as the Eastern Officer Basin, and covers approximately 100 000 square kilometres. It occupies the area between the Precambrian Gawler Craton to the south and the Musgrave Block to the north (Fig. 1). The basin comprises two troughs, the Munyarai to the north and the Wintinna to the south, separated by the Ammaroodinna High. Both regional gravity and depth to magnetic basement maps (Gerdes, 1982) indicate the Munyarai Trough as the deepest part of the Eastern Officer Basin.

Seismic interpretation was carried out in the southwestern part of the Eastern Officer Basin, to examine the structural evolution and configuration of the area, and potential hydrocarbon trap structures in the Murnaroo Formation. Particular attention was given to the role played by the salt or evaporite tectonics in the deformation of the Proterozoic section.

## GEOLOGICAL SETTING AND STRATIGRAPHY

The Eastern Officer Basin is underlain by gently northward dipping basement. The Basin contains a thick Late Proterozoic to middle Palaeozoic section. The Proterozoic sequence represents at least two thirds of the infill, the remainder being of Palaeozoic age (Fig. 2). The Proterozoic succession thins to the south, and the earliest infill of the basin was penetrated on the southern margin of the Munyarai Trough in Giles 1. The deepest Proterozoic units (Pindyin, Alynia, Tarlina and Meramangye beds) of the Basin have only been identified at this site. The Alynia, Tarlina and Meramangye beds are informal stratigraphic names. They are used in this sense for ease of reference to the work by Comalco Aluminium Ltd (Comalco).

The general stratigraphy of the basin is summarised in Figure 2 and is that of Comalco. Further drilling may reveal the presence of additional stratigraphic units which will necessitate revision of the pre-Murnaroo Formation succession.

<u>Pindyin beds</u> (150 m thick in Giles 1): Interpreted as the basal sediments of the Officer Basin (Major, 1973). These Proterozoic sediments consist of sandstones with siltstone interbeds, and grade upward to the Alynia beds in Giles-1.

<u>Alynia beds</u> (45 m in Giles 1): These consist of dolomitic anhydritic sandstones, dolomitic and anhydritic siltstones, and sandy anhydrite beds (Stainton et al., 1988), interpreted as deposited in a sabkha environment. The contact with the overlying unit is unconformable. The Alynia beds are of particular importance in the evolution of the basin, as they constitute the ductile layer upon which part of the overlying Proterozoic sedimentary cover slid. The diapiric features observed in this part of the Officer Basin are also interpreted to have originated from the evaporitic Alynia beds.

<u>Tarlina beds</u> (168 m in Giles 1): This unit unconformably overlies the Alynia beds (Stainton et al., 1988). In Giles 1 the Tarlina beds are predominantly sandstones with thin siltstone and claystone interbeds. The sandstones are usually poorly sorted and often non bedded. The depositional environment is uncertain.

<u>Meramangye beds</u> (193.5 m in Giles 1). These conformably overlie the Tarlina beds and grade upwards into the Murnaroo Formation. They consist of finely laminated siltstones and claystones, with abundant cross stratification, graded bedding, and slumped cross beds. Minor anhydrite nodules and veins occur in the upper part of the section. The Meramangye beds are interpreted as shallow water, possible deltaic deposits.

<u>Murnaroo Formation</u>: 285 m in Giles 1; 109 m in Munta 1, Stainton et al. (1988)). The formation consists of moderately well sorted sands, often containing chert, quartzite and mafic volcanic fragments. The top of the Formation was selected at

the base of the first laminated calcareous siltstone bed of the overlying Rodda beds (Gatehouse, 1986).

Rodda beds: By far the thickest unit of the Officer Basin, the Rodda beds can reach at least 4700 m in the northern margin of the basin (W. Preiss, pers.com.).

The Rodda beds consist of laminated calcareous and dolomitic siltstones, limestones and sandstones, and show characteristics of deep water sediments (Stainton et al., 1988). They are limited at the top by erosional truncation and unconformity associated with the Petermann Ranges Orogeny Basal Cambrian sediments unconformably overlie Rodda beds in the study area.

Although undivided to date, and in spite of apparent monotonous lithology, the Rodda beds encompass several unconformity-bounded seismic units which are discussed further in this text.

## SEISMIC DATABASE

The most recent seismic data covering the seismic surveys conducted by Comalco in 1984, 1985 and 1986. The line spacing varies from less than 2 km to over 10 km (Fig 3). Interpretation of these data forms the basis of this investigation. The grid is generally suitable for a broad understanding of structure and evolution of the area, and the distribution of the seismic units. However, detailed structural interpretation (particularly at the Murnaroo Formation level) requires additional data.

The seismic horizons picked in the interpretation were tied to stratigraphic units at Giles 1, Munta 1, Karlaya 1, Lairu 1, Ungoolya 1 and Munyarai 1. Seismic tie line Ip1-2 (Amoco, 1987) was used to correlate the horizons between Ungoolya 1 and Munyarai 1.

The Comalco sections are displayed at 1:15000 horizontal scale (migrated stacks and final stacks) and at various scales (from 1:50000 to 1:56700) for the compressed final stacks. Migrated stacks and final stacks were used for the current interpretation. The seismic datum is 200 m above M.S.L for the 1986 lines and 100 m above M.S.L for the 1984 and 1985 lines. Amoco (1987) lines have seismic datum at 305 m above M.S.L. Additional bulk shift of datum between the surveys result from the use of different statics correction velocities (2800 m/s in the 1986 Comalco data, 2000 m/s in the 1984 and 1985 Comalco data, 2600 m/s in Amoco 1987 data).

Continuity of the low frequency and deep horizons is good, although there is poor high frequency response and low resolution. This results mainly from the use of the Thumper (weight drop) as a seismic source for the Comalco surveys.

## SEISMIC SOURCES

A test was carried out in early 1983 by Comalco in PEL 23, to evaluate the relative cost effectiveness of four seismic sources: Thumper, Vibroseis, downhole dynamite, and detonating cord. The results of the tests have been presented by Cucuzza and Akerman (1984), and are summarized here. Thumper performed best in the deeper part of the section whilst Vibroseis produced the better shallow data, owing to the high frequency content. It should be noted, however, that the widest spectral band width was obtained by the down hole dynamite and detonating cord, although the resulting data quality from both sources was hampered by poor signal/noise level. For the down hole dynamite, these poor results could probably be due to the charge being exploded at 30 m, in the weathering level (up to 100 m thick in that area), and for the detonating cord they may be attributed to a lower fold of CDP coverage (12) when compared to the Thumper line (48 fold).

In late 1983, a second series of tests compared different processing sequences of Vibroseis and Thumper data (Cucuzza et al., 1984) whilst dynamite and detonating cord were not included in these tests. The Vibroseis provides a significantly better resolution than the Thumper down to 1.0 s two-way time but deteriorates below this level. Processing of both Thumper and Vibroseis data with identical parameters indicates that the differences are source related. The Thumper power spectrum and filter tests (Cucuzza and Akerman, 1984) indicate that there is good continuity between 15-40 Hz, and very little signal beyond 40 Hz. The lower frequencies generated down to 10 Hz by the weight drop must be responsible for the better continuity of the deep seismic events. Conversely, filter band tests indicate very little energy between 10-20 Hz in the Vibroseis data, whilst the detonating cord has better coherency in the 15-50 Hz.

## SEISMIC INTERPRETATION

Table 1 (below) summarises the characteristics of the horizons picked in the current study, the stratigraphic code is derived from Stainton et al. (1988). The two prominent horizons within the Proterozoic section are horizons F5 and F.

F5 divides the Proterozoic section into two packages: the lower package is characterized by a constant thickness over the basin, from the Ammaroodinna high in the south, to the Munyarai Trough in the north. The deposition of the units forming this package (from the Pindyin beds to the lower part of the Rodda beds) predates subsequent tectonic events, and their facies distribution is expected to be governed solely by depositional environment.

Table 1: Horizons Characteristics

| HORIZON | CONTINUITY | STRATIGRAPHY | TYPE | COMMENT |
|---|---|---|---|---|
| E | Good | Top Rodda beds | Sequence boundary | Basal Cambrian unconformity pinches on F |
| $E_3$ | Good | Intra Rodda beds | | Pinches on F |
| F | Good to fair | Intra Rodda beds | Sequence boundary | Erosional surface, canyon cutting horizon. Merges with F5 on the Ammaroodinna platform. Seals the faults affecting the underlying sequences. |
| $F_5$ | Good | Intra Rodda beds | Sequence boundary | Angular unconformity on the southern fractured zone, top of a package of faulted sediments. |
| G | Good | Top Alynia beds | Unconform-ity | Faulted horizon. Pinches on $G_2$ on the southern margin of the basin. |
| $G_2$ | Fair to good | Near top Pindyin beds | | Pinches on basement on the southern margin of the basin. |
| H | Good | Top Basement | | |

F is a major erosional surface which has cut incisions several hundred metres deep in the Officer Basin. These canyon-like features occur within the Rodda beds on the southern margin and the deepest part of the basin. They may be related to kilometre-deep incisions which are observed in the northern Flinders Ranges (Von der Borch et al., 1982). The subaerial or submarine origin of these features is currently a matter of debate (Von der Borch et al., 1989). In the Officer Basin the cutting of the canyons is interpreted as being contemporaneous with diapiric activity, and their infill as a time equivalent of the diapiric peripheral sink deposits (F to E). An association between diapiric activity (Lemon, 1985) and canyon cutting has also been suggested in the Flinders Ranges (Von der Borch et al., 1989).

Table 2 synthesises the characteristics of the seismic units.

Table 2: Interval Characteristics

| INTERVAL | STRATIGRAPHY | UPPER BOUNDARY | LOWER BOUNDARY | COMMENTS |
|---|---|---|---|---|
| E-E 3 | Rodda beds | Unconformity | Onlap to concordant | Infill of secondary diapir peripheral sink. |
| F-$E_3$ | Rodda beds | Concordant | Onlap | Canyon infill. Infill of first diapir peripheral sink. |
| $F_5$ | Rodda beds | Erosional truncation offlap | Onlap to downlap | Syntectonic sequence, thickens to the north. |
| G-$F_5$ | Rodda beds<br>Murnaroo Formation<br>Meramangye beds<br>Tarlina beds | Offlap<br><br>to concordant | Downlap | Faulted, with mass movement on the Alynia beds. |
| $G_2$-G | Alynia beds | Unconformity | Concordant | Faulted at the top. Ductile evaporitic series forming a decollement surface. |
| H-$G_2$ | Pindyin beds | Concordant | Onlap | Thin unfaulted veneer of sediments. |
| Basement | | | | |

Although believed to be widespread, the actual distribution of the Murnaroo Formation has not been mapped to date. Apart from resolution loss due to the low frequency energy source, the difficulty in mapping the Murnaroo Formation results from the absence at the top of the Formation of either a sequence boundary or a seismically visible unconformity, and the absence of intra-formational seismic markers.

Speculatively, the absence of a seismic event at the top the Formation could be of geological origin (lack of acoustic impedance contrast). In Munta 1, the contact between the carbonaceous Rodda beds and the Murnaroo Formation sandstones (at 1794.5 m) is characterized by a significant density contrast and a slight change in velocity which result only in a small contrast in acoustic impedance. This results in a very small reflection coefficient, thus generating a very small reflection event which would remain unresolved with the available data.

Structures in the Murnaroo Formation have been previously deduced (Stainton, et al., 1988) from time contours of horizons located below and above the formation, namely horizon G (top Alynia beds) and horizons F to E (intra Rodda beds). Fig. 5 illustrates the difficulty of assessing the structures at the top Murnaroo Formation level using only horizons G and F.

In this study, horizon F5 was selected in an attempt to adequately represent the structures at the Murnaroo Formation level (Fig. 4).

## TECTONIC CONFIGURATION

The study area encompasses five distinct zones (Figs 3 and 6), from south to north:

1) A platform overlying the Ammaroodinna High
2) A southern faulted zone
3) A diapiric wall
4) A northern faulted zone
5) A deep basin extending to the Munyarai Trough to the north

A discussion of each of these zones follows:

1) On the platform, horizons F and F5 merge (Fig. 3) through non deposition (or total erosion). The platform is incised by deep canyons cut by horizon F (intra Rodda beds unconformity), which are infilled by subsequent Rodda beds units (F5-E3 and E3-E).

South verging thrusts apparently related to the Alice Springs Orogeny (Devonian-Carboniferous time) have generated low amplitude folds on the platform (e.g. the Giles 1 structure). The intensity of deformation augments to the east and the thrusts of platform in the Giles 1 area are the west southwestward termination of the fold and thrust complex of the Marla area.

2) The southern faulted zone is a 30 km wide east northeast trending area affected by a dense network of east-northeast normal faults. The faults present remarkable continuity and almost constant throw along strike. They define narrow (average 1 km wide) elongated tilt blocks (occasionally over 10 km long). The faults are rotational planar (for both beds and fault are rotated). Their average true dip is 80° north. The bedding planes within the rotated blocks dip 7° to the south. The amount of extension derived from these values is less than 10 % (Wernicke and Burchfiel, 1982).

The onset of faulting is shown by an angular unconformity (horizon F5) resulting from the rotation of the blocks. The blocks are composed of a sedimentary package corresponding to the interval G-F5, which includes the Murnaroo Formation (Figs 5 and

6). The faults are sealed by horizon F, and observed to die out and sole within the ductile layers of the Alynia beds. Seismic interpretation does not provide conclusive evidence for progressive younging of the faults away from the main diapiric wall. The remarkably constant dip angle of the faults along north - south and north northwest cross sections as well as the lack of dip change and overall constant thickness of the faulted beds (pre-F5 sequences) suggest that the fracturing occurred approximately simultaneously over the entire area.

The southern fractured zone also shows a strong erosional truncation at F, and by a thin F5-F sequence.

3) The prominent structural element of the area is a 45 km long, 2 to 3 km wide evaporitic wall. The western part of the structure is the most evolved, having reached a piercement stage, whereas the eastern part remained in a pillow stage. Other minor evaporitic pillows are also present in the area (Fig. 3). These structures originated from deformation of the evaporitic layers of the Alynia beds.

The reactivation of the main diapiric wall during Palaeozoic compressional phases (Alice Springs Orogeny) resulted in an apparent thrust of the structure alternatively to the north and the south (Fig. 3).

4) The northern faulted zone is much narrower than its southern equivalent, and extends only a few kilometres in a north-south section. The faults are of the same type, and trend in the same direction as those in the

southern faulted zone, but dip to the south, whilst the rotated blocks dip to the north.

5) The deep basin zone, north of the main salt wall and its fringing northern fracture zone, is characterized by considerable thickening of the sequence F5-F. A 1420 m increase in thickness of the sequence is estimated between Munta 1 and Ungoolya 1. However, Horizon F remains a prominent erosional event in the basin and incises deep canyons through the F5-F sequence. These canyons are infilled by subsequent units of Rodda beds (F-E3).

Palaeozoic compressional phases generated folds and south verging thrusts in the deep basin zone (Munyarai Trough). This is indicated by the Munyarai 1 structure where intensity of deformation decreases toward the south.

## TECTONIC EVOLUTION

The tectonic evolution of the Proterozoic section can be divided in four stages (Fig. 7).

Stage 1, "platform stage", corresponds to the deposition of a sedimentary section of even thickness over most of the area, with horizon F5 (lower Rodda Beds) marking the top of the sequence.

Stage 2 is the creation of a topographic gradient to the north, during the interval F5-F, with a consequent gravity driven slide and collapse of the sedimentary cover upon the ductile Alynia beds. The characterization of the individual tectonic provinces is clearly outlined by the increased thickness of sequence $F_5$-F to the north (Munyarai Trough), and the angular unconformity $F_5$

in the southern faulted zone. This sudden collapse of the basin to the north could result from the creation of a foreland trough at the southern front of the Musgrave Block (W. Preiss, pers. comm.). This remains to date speculative. The answer to the origin of this movement is likely to be found at the boundary between the Musgrave Block and the Eastern Officer Basin.

Evaporites migrated to the base of the south fractured zone, and formed pillows, during the interval $F_5$-F.

Stage 3 is the piercement stage of the evaporitic structure, and the creation of peripheral depression (withdrawal syncline or peripheral sink (Seni and Jackson (1983), Warren (1989)) around the main evaporitic wall.

Two pulses in the growth of the structure can be detected, they are associated with the deposition of units F-$E_3$, and $E_3$-E.

The compressions shown in Stage 4 are attributed to the Alice Springs Orogeny, although erosion or non deposition of part of the Palaeozoic section (Middle-Late Devonian) precludes an accurate determination of the timing of major fault activity. The compressions are relatively modest, but their intensity augments both to the northeast (Marla area) and to the north. Southwest-northeast thrust faults in the Marla area indicate a horizontal displacement of 8 km or more (Dunster, 1987). Seismic, gravity and magnetic data show that the south margin of the Musgrave Block is south verging overthrust (Milton and Parker (1973); Ivic (1986).

PETROLEUM ASPECTS

**Reservoirs, source rocks and seals**

The Murnaroo Formation and the Rodda beds of the Proterozoic section are of particular interest in terms of petroleum potential. The Rodda beds could qualify as marginal source rocks (average T.O.C. of 0.16%) with intervals of 0.13 to 0.81% T.O.C. in Karlaya 1 and Ungoolya 1. Oil stains and bleeds in these two wells (Stainton et al., 1988), are also encouraging indication of hydrocarbon accumulations.

The Murnaroo Formation is considered both as potential source and reservoir for hydrocarbons, with porosity ranging from 10 to 22% at Giles 1 and from 12 to 16% at Munta 1. Permeability averages 110 md at Giles 1 and 90 md at Munta 1. Potential structures in the Murnaroo Formation could be sealed by the extensive cover of the dense, tight and impermeable Rodda beds.

This interpretation has concentrated on the Proterozoic section, in particular the potential hydrocarbon trap in the Murnaroo Formation. The formation has been encountered in 12 widely-spaced mineral and hydrocarbon exploration wells (e.g. the Birksgate 1, Murnaroo 1, Observatory Hill 1 wells) with a maximum known thickness of 580 m in the SADME hole 5002 (Lake Maurice East). Stainton et al. (1988) suggested that the Murnaroo Formation, as a potential reservoir, is present throughout the area formerly covered by PEL 23 and extends further north into the Munyarai Trough (formerly PEL 29).

The Murnaroo Formation belongs to a sequence (G-F5) which extends over the southern margin of the Officer Basin and the Munyarai Trough with constant thickness. Although the top of the Formation is not outlined by a seismic marker, it is interpreted to be present below horizon $F_5$ from the Ammaroodinna High platform to the Munyarai Trough.

As sequence G-$F_5$ predates the subsequent tectonics, the distribution of the depositional facies cannot be directly derived from the tectonic configuration of the basin.

The Rodda beds encompass several units deposited in various tectonic and sedimentary environments. The ability of these units to source, trap or seal hydrocarbons is likely to vary accordingly.

The lower part of the Rodda beds (pre-$F_5$) is associated with Murnaroo Formation and predates the tectonic differentiation of major troughs within the basin.

The tectonic configuration of the area evolved during the deposition of sequence $F_5$-F (upper Rodda beds). This tectonic activity is likely to have governed the distribution of the depositional facies, from slope deposits on the southern fractured zone, to deep basin sediments in the Munyarai Trough.

The upper part of the Rodda beds consists of diapir peripheral sink and canyon infill. The canyon-like features are observed from the southern margin of the basin to the deepest part of the Munyarai Trough (Amoco, 1987). The cutting of these incisions may have occurred in different contexts (i.e. submarine in the deep basin to subaerial on the southern margin). The sediments are interpreted to have travelled through these canyons via the southern fractured zone (palaeoslope) to the deeper parts of the Munyarai Trough. The nature and facies of the infill is likely to show an increase in depth of deposition, and deep marine deposits (?turbidites) could be present in the deepest part of the Munyarai Trough.

**Trap Styles**

Normal faults. Intense fracturing associated with the collapse of the sedimentary cover during the first stage of evaporitic withdrawal is evident on the southern margin of the basin (Figs 4,5,6). This structural style has generated four way closures (at $F_5$ level) although the density of the faults dramatically limits the size of the structures (Fig. 4). The largest of them was drilled in Munta 1. However, a tighter seismic grid is required for a thorough assessment of this type of trap.

Thrust folds. Anticlinal thrust folds are present on the Ammaroodinna High, and in deeper parts of the basin. They can show four way closure from basement to surface. The timing of the thrust is considered to be Middle Palaeozoic (Alice Springs Orogeny). The amplitude of the compressional movements, and hence possible closure, augments to the east, towards the Marla area. Giles 1 and Ungoolya 1 are interpreted to have tested this type of trap. However the Ungoolya structure is considered to result from Palaeozoic (Alice Springs Orogeny) reactivation of a Proterozoic (intra Rodda beds) evaporitic structure.

Paleoreliefs. Karlaya 1 tested a paleorelief isolated by the canyon cutting event (horizon F). The structure is also dependent on a normal fault associated with the evaporitic withdrawal phase. Lairu 1 is interpreted to have penetrated a thick section 720m) of diapiric peripheral sink or canyon infill (seismic interval F to E), on the flank of an evaporitic pillow structure.

The remaining trap types, untested to date, are associated with the main diapiric wall: they are fault traps along the diapiric wall in the western part of the evaporitic structure, and possible domal closure to the east where the structural development remained in the pillow stage. The formation of a limestone/anhydrite cap above and around the evaporitic wall could further enhance the reservoir quality of the underlying formations.

REFERENCES

Amoco, 1987. 1987 PEL-29 Seismic survey Processing and Interpretation Report. East Officer Basin. *South Australia. Department of Mines and Energy. Open file Envelope 6766(2)*, (unpublished).

Cucuzza, G., Akerman, J., 1984. Seismic source comparison in PEL 23, South Australia. *In: Proceedings of the Second Petroleum Geophysics Symposium, Melbourne*, pp. 413-436.

Cucuzza, G., Akerman, J. and Gatti, G., 1984. Results from an experimental survey using the GEOCOR IV seismic acquisition system. *Exploration Geophysics*, v. 16, (2/3): 198-204.

Dunster, J.N., 1987. Sedimentology of the Ouldburra Formation (Early Cambrian) northeastern Officer Basin, South Australia. *University of Adelaide, M.Sc. thesis* (Unpublished).

Gatehouse, C.J., Benbow, M.C. and Major, R.B., 1986. The Murnaroo Formation of the Officer Basin. *South Australia. Geological Survey. Quarterly Geological Notes*, 93: 6-12.

Gerdes, R.A., 1982. The interpreted depths to magnetic Basement Map of South Australia. *South Australia. Geological Survey. Quarterly Geological Notes*, 83.

Ivic, D., 1986. Summary of geophysical interpretations of the Everard thrust, N.E. Officer Basin, South Australia. *South Australia. Department of Mines and Energy. Report Book*, 86/78.

Lemon, N.M., 1985. Physical modelling of sedimentation adjacent to diapirs and comparison with late Precambrian Oratunga breccia body in central Flinders Ranges, South Australia. *AAPG Bulletin*, 69: 1327-1338.

Major, R.B., 1973. The Pindyin Beds. *South Australia. Geological Survey. Quarterly Geological Notes*, 46: 1-5.

Milton, B.E. and Parker, A.J., 1973. An interpretation of geophysical observations on the northern margin of the eastern Officer Basin. *South Australia. Geological Survey. Quarterly Geological Notes, 36: 10-15*.

Seni, S.J. and Jackson, M.P.A., 1983. Evolution of salt structures, East Texas diapiric province. Parts 1 and 2, *AAPG Bulletin* 67: 1219-1274.

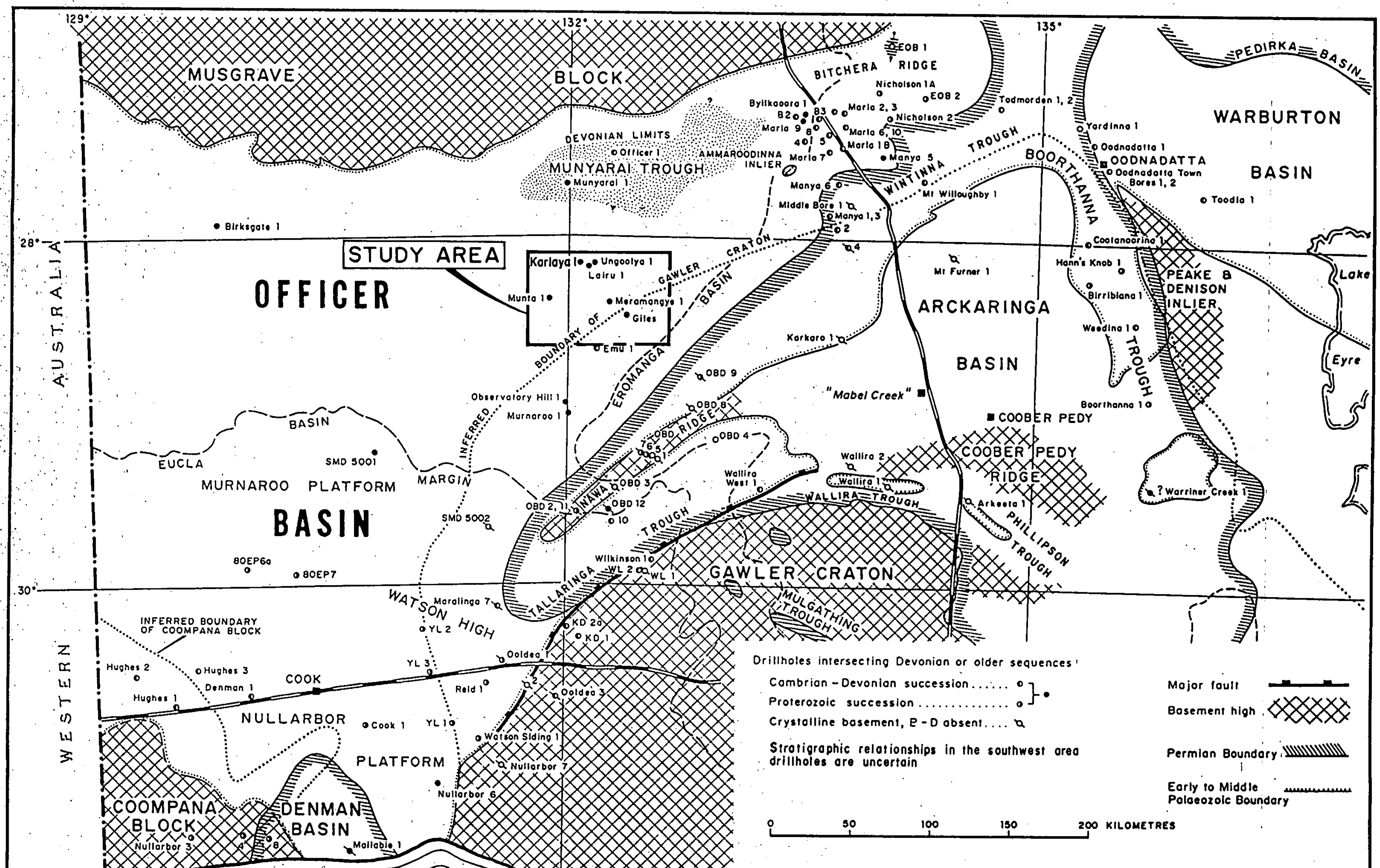
Stainton, P.W., Weste, G. and Cucuzza, G., 1988. Exploration of PEL 23 and PEL 30, eastern Officer Basin,SA, 1983-88. *South Australia. Department of Mines and Energy. Open file Envelope* 5073 (unpublished).

Von der Borch, C.C., Smit, R. and Grady, A.E., 1982. Late Proterozoic submarine canyons of Adelaide Geosyncline, South Australia. *AAPG Bulletin*, 66: 332-347.

Von der Borch, C.C., Grady, A.E., Eickhoff, K.H., Dibona, P. and Christie-Blick, N., 1989. Late Proterozoic Patsy Springs Canyon, Adelaide Geosyncline: submarine or subaerial origin?. *Sedimentology*, 36: 777-792.

Warren, J.K., 1989. Evaporite-hydrocarbon association: the importance of salt structures. *PESA Journal*, Sept 89: 32-37.

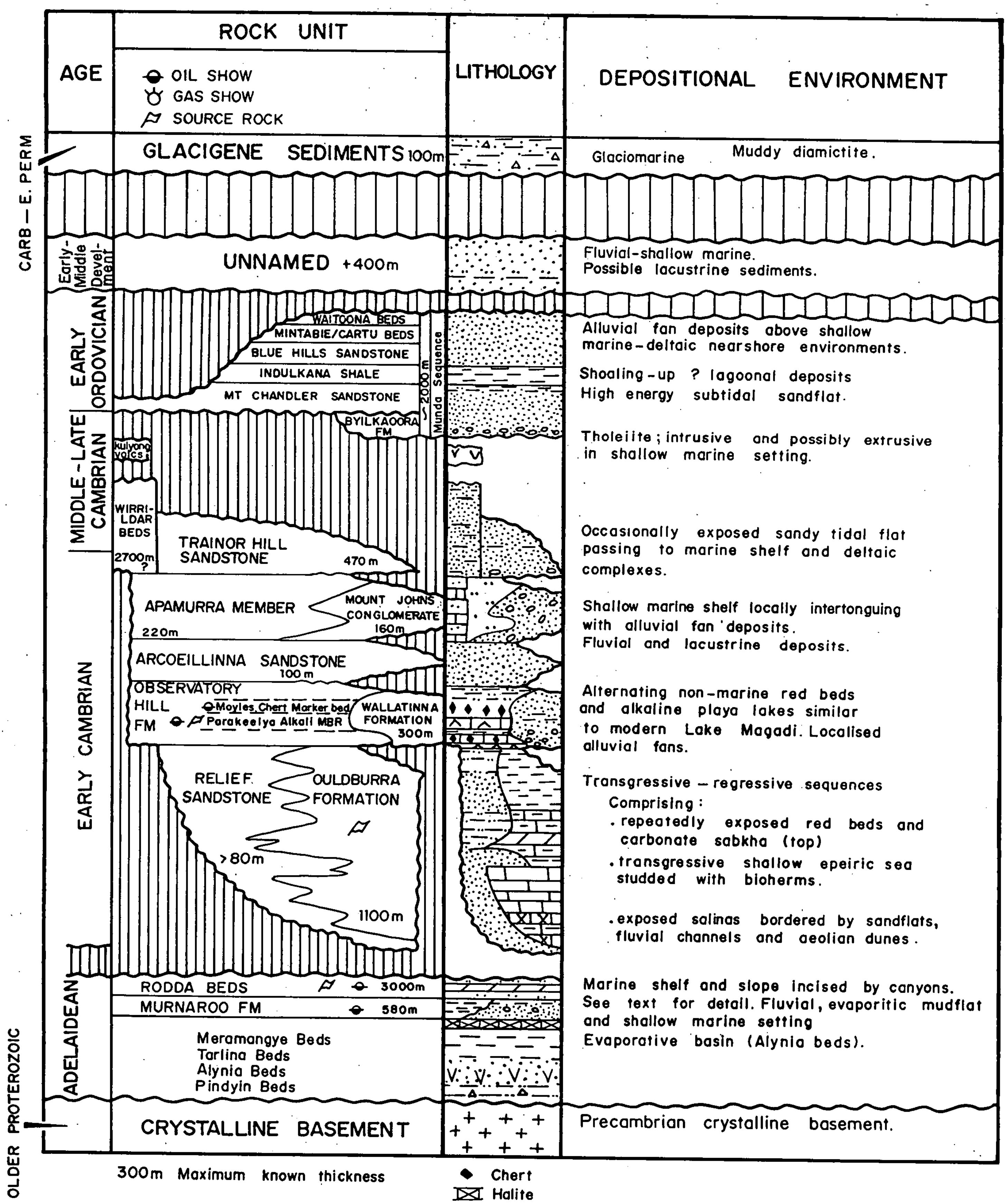
Wernicke, B. and Burchfiel, B.C., 1982. Modes of extensional tectonics. *Journal of Structural Geology*, 4 (2): 105-115.




OFFICER BASIN
GEOLOGICAL SETTING

Figure 1

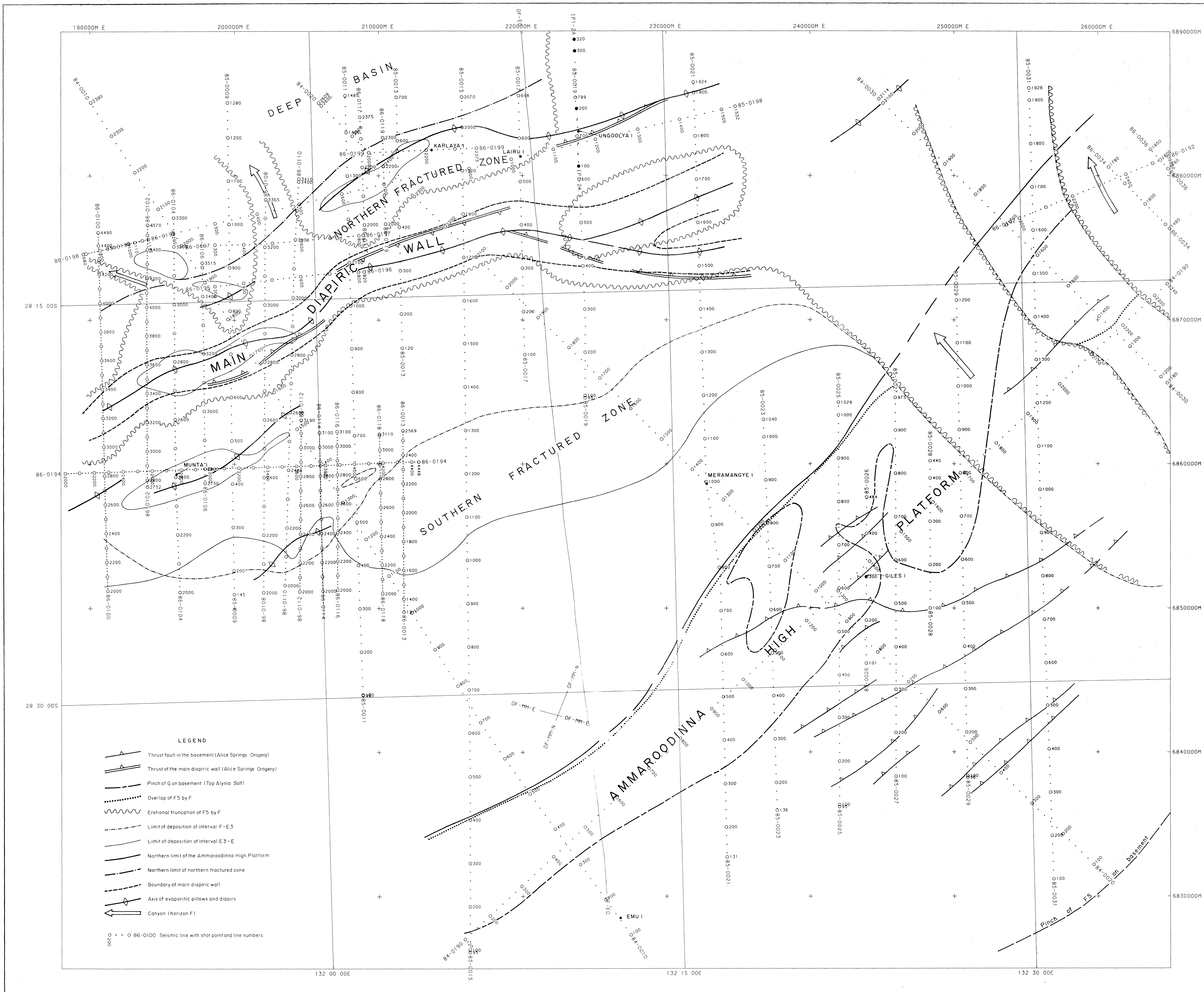
5062




S21757

# OFFICER BASIN GEOLOGICAL SUMMARY

Figure 2




SCALE

Kilometres 2 0 2 4 6 8 10 Kilometres

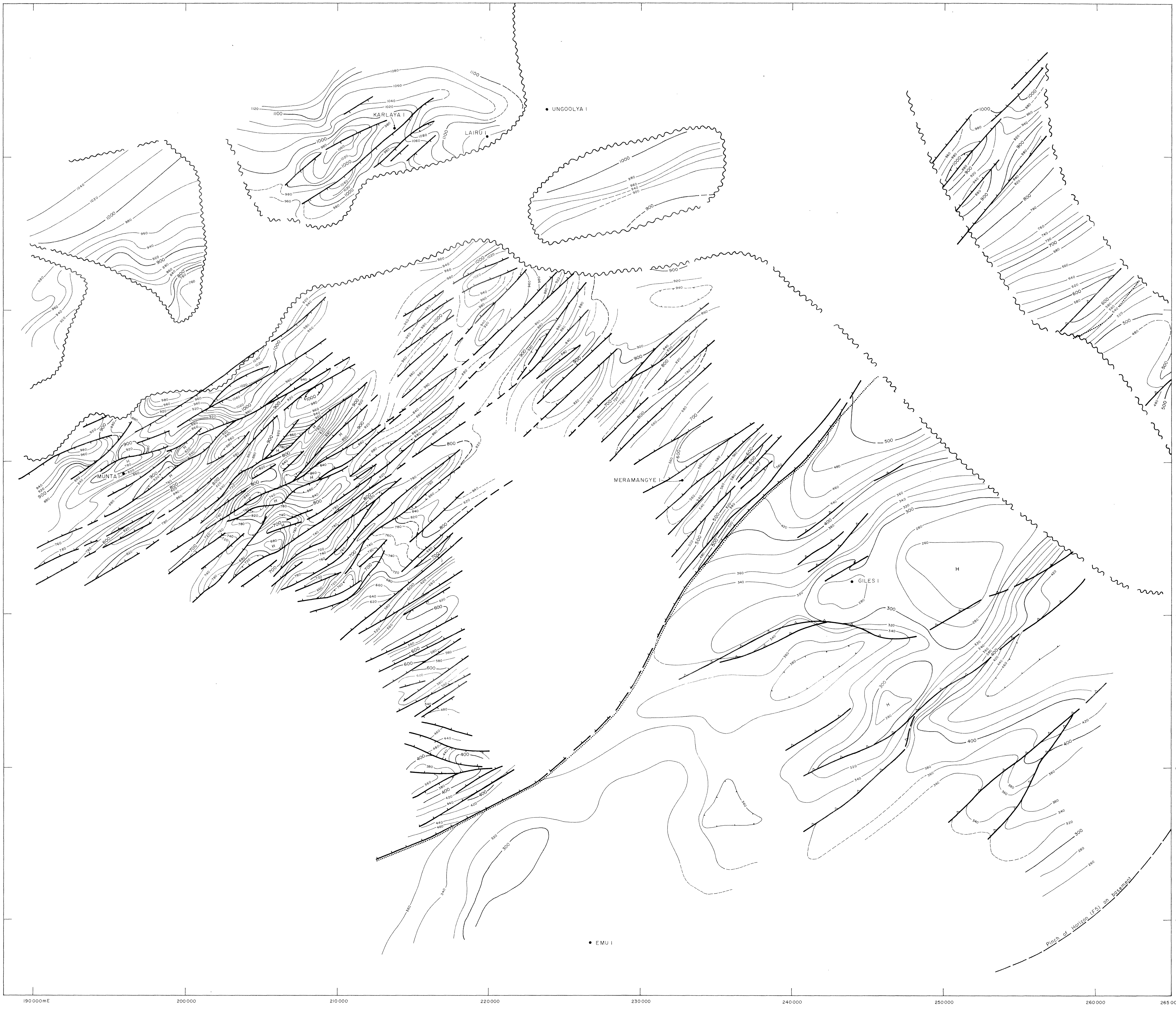
UNIVERSAL TRANSVERSE MERCATOR PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN 135 00 00E

Fig. 3

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

SUMMARY OF SEISMIC INTERPRETATION
IN THE OFFICER BASIN
SEISMIC LOCATION MAP
STRUCTURAL ELEMENTS
AND DISTRIBUTION OF
MAJOR PROTEROZOIC UNITS

| | |
|---|---|
| COMPILED | B. Thomas |
| DRAWN | J. Gray |
| DATE | June 1990 |
| CHECKED | |
| C.D.O. DATE | 2 11.90 |
| SCALE | 1 100 000 |
| PLAN NUMBER | 90-445 |




LEGEND

Fault

Reverse fault

Erosional truncation of F5 by F

Overlap of F5 by F

Seismic datum : 200m A.M.S L.

Two way time in milliseconds

SCALE

Kilometres 2 0 2 4 6 8 10 Kilometres

Fig. 4

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

SUMMARY OF SEISMIC INTERPRETATION IN THE OFFICER BASIN

STRUCTURE ON HORIZON F5

| | |
|---|---|
| COMPILED | B. Thomas |
| DRAWN | J Gray |
| DATE | June 1990 |
| CHECKED | |
| C.D.O. | DATE 2 11 90 |
| SCALE | 1 100 000 |
| PLAN NUMBER | 90-446 |

Fig. 5

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

SUMMARY OF SEISMIC INTERPRETATION IN THE OFFICER BASIN

SEISMIC LINE 86-0104

| | |
|---|---|
| COMPILED | B. Thomas |
| DRAWN | J Gray |
| DATE | June 1990 |
| CHECKED | |
| C.D.O. | DATE 2/1/90 |
| SCALE | As shown |
| PLAN NUMBER | 90-447 |

COMALCO ALUMINIUM LIMITED
PEL 23
SOUTH AUSTRALIA
COMALCO LINE: 84-0010
S.P.: 2390-100
FINAL STACK (COMPRESSED)

## RECORDING PARAMETERS

RECORDED BY PETTY-RAY GEOPHYSICAL CREW 6316

| | |
|---|---|
| SOURCE : THUMPER | RECORDING UNIT : MDS 10 |
| THUMPS : 8 X 7.5 M | GEOPHONE TYPE : MD79 10 HZ |
| WITH CHEBYCHEV WEIGHTING | GEOPHONE PATTERN : 24 X 1.25 M |
| GROUP INTERVAL : 30 M | IN LINE 24 PHONES/TRACE |
| SOURCE INTERVAL: 30 M | GAIN CONTROL : IFP |
| SPREAD : 1830-60-0-60-1830 M | FIELD FORMAT : SEG B 1600 BPI |
| 120 TRACE 60 FOLD | FILTER : 12 - 62.5 HZ |
| SAMPLE RATE : 4 MSEC | LINE DIRECTION NW ------->> SE |
| RECORD LENGTH : 4 SEC | |
| RECORDING MODE : VARISOURCE - NORMAL | |

| SEQUENCE | PROCESSING PARAMETERS |
|---|---|
| DEMULTIPLEX | OUTPUT : 2.5 SEC DATA |
| F-K FILTER | VELOCITY FILTERING |
| GAIN RECOVERY | ALPHA : 0.1 N : 1.0 |
| FILTER | BAND PASS 5/10 - 60/65 HZ |
| DECONVOLUTION | PREDICTIVE DECONVOLUTION WITH 28 MSEC GAP 100 MSEC OPERATOR LENGTH 5 % WHITE NOISE |
| TRACE EQUALIZATION | 500 MSEC AGC |
| WEATHERING STATICS | HAND PICKED FROM REFRACTION BREAKS |
| NMO CORRECTIONS | CONSTANT VELOCITY STACK ANALYSES APPROXIMATELY ONE PER KILOMETRE |
| MUTE | OFFSET : 210/330/1110/1830 M TIME : 0/220/ 720/ 900 MSEC |
| DATUM STATICS | DATUM - 100 M ABOVE SEA LEVEL CORRECTION VELOCITY - 2000 M/SEC |
| RESIDUAL STAICS | SURFACE CONSISTENT PLUS CDP TRIM |
| STACK | 60 FOLD |
| FILTER | 5/10 - 60/65 HZ AT 0 - 1200 MSEC; 5/10 - 40/45 HZ AT 1600 - 2500 MSEC |
| SCALING | DESIGNED WINDOW 50 TO 2000 MSEC; 2000 TO 2300 MSEC |
| MIX | 2 : 1 MIX WITH DECIMATION |

## DISPLAY

BIAS: ZERO
POLARITY: NEGATIVE VALUE ON TAPE DISPLAYED AS TROUGH.
VERTICAL SCALE: 10.0 CM/SEC. HORIZONTAL SCALE: 16.8 TR/CM

SCALE 1:50398

0 1.0 2.0 3.0 4.0 KM
SOUTHEAST

DATE RECORDED: AUG 84 DATE PROCESSED: SEPT 84
QUALITY CONTROL: Russell Mitchell

HOSKING GEOPHYSICAL CORP.
(AUSTRALIA)

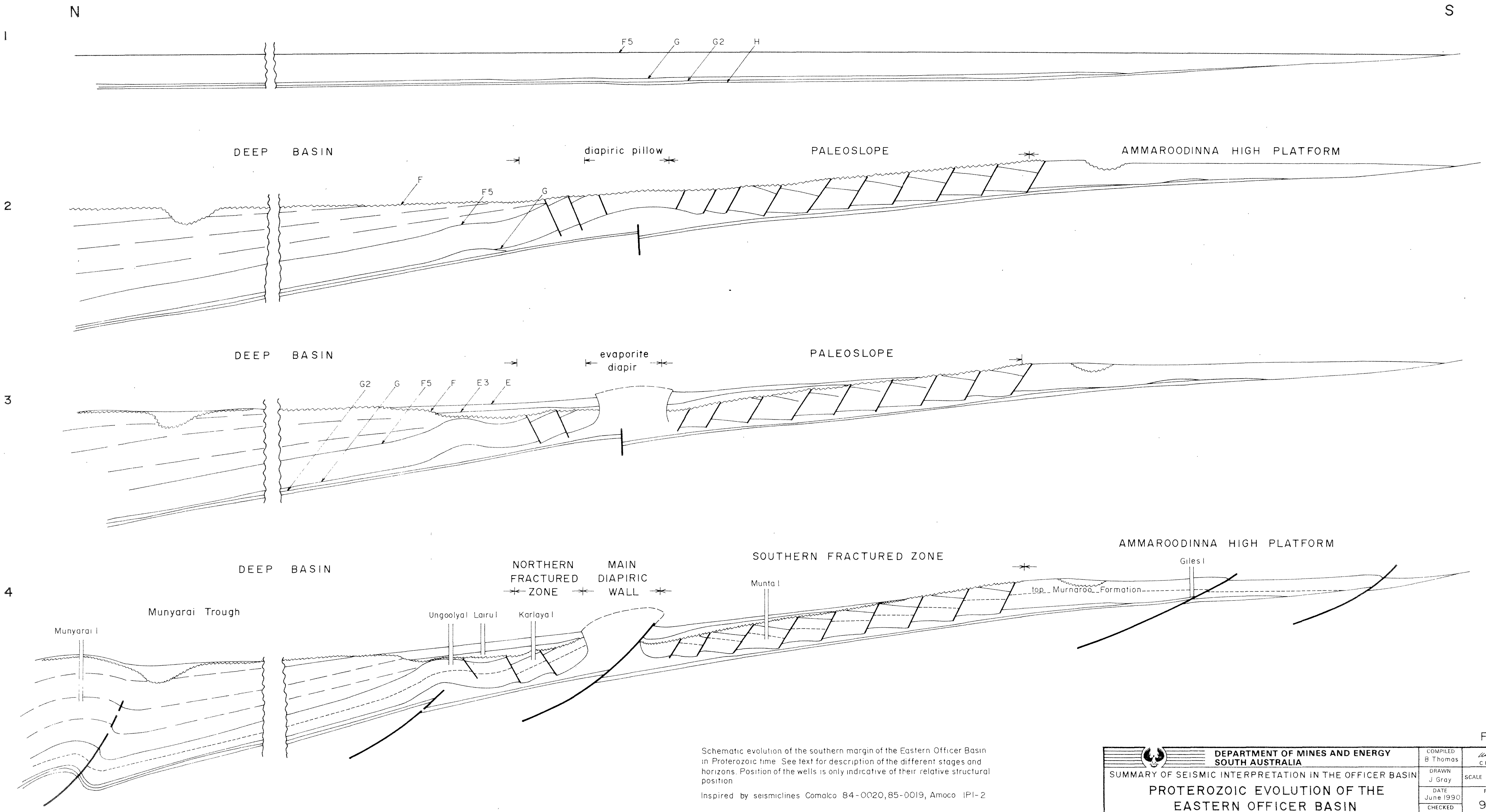

Fig. 6

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SUMMARY OF SEISMIC INTERPRETATION
IN THE OFFICER BASIN

SEISMIC LINE 84-0010

| | |
|---|---|
| COMPILED | B. Thomas |
| DRAWN | J. Gray |
| DATE | June 1990 |
| CHECKED | |
| C.D.O. | DATE 2·11·90 |
| SCALE | As shown |
| PLAN NUMBER | 90-448 |




Schematic evolution of the southern margin of the Eastern Officer Basin in Proterozoic time. See text for description of the different stages and horizons. Position of the wells is only indicative of their relative structural position

Inspired by seismiclines Comalco 84-0020, 85-0019, Amoco IPI-2

Fig. 7

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B Thomas | CDO 2·11·90 DATE |
|---|---|---|
| SUMMARY OF SEISMIC INTERPRETATION IN THE OFFICER BASIN | DRAWN J Gray | SCALE |
| PROTEROZOIC EVOLUTION OF THE EASTERN OFFICER BASIN | DATE June 1990 | PLAN NUMBER 90-449 |
| | CHECKED | |

5062