DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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A PETROGRAPHIC STUDY OF THE SEDIMENTS IN SEVEN OFFICER BASIN STRATIGRAPHIC WELLS

GEOLOGICAL SURVEY

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ABSTRACT

Cores and cuttings from seven stratigraphic wells in the Officer Basin were examined principally to develop a depositional model for sediments of pre-Permian age.

Evidence from six of the studied wells suggests that an epeiric environment prevailed during ?Cambrian time.

INTRODUCTION

The Officer Basin covers an area of at least 80 000 sq. km in the northwest of South Australia and extends into Western Australia (Fig. 1). It has been defined by Wopfner (1972) as a Cambro-Devonian intracratonic basin lying between the Musgrave and Gawler Blocks (Fig. 2). It is asymmetrical in section, with the relatively flat lying sediments being thickest in the north (Fig. 3).

Exploration began in 1954, when an aeromagnetic survey by the Bureau of Mineral Resources, Geology and Geophysics (BMR) first identified the basin. Since then a number of stratigraphic wells have been drilled (Table 1) following geophysical surveys by the South Australian Department of Mines and Energy (SADME) and private companies.

There are no Petroleum Exploration Licences currently held in the Officer Basin, although potential source rocks have been recognised recently in several wells. The SADME currently is re-evaluating the hydrocarbon potential of the Officer Basin, and this largely petrographic study of the pre-Permian sequences in seven stratgraphic wells (Fig. 2) forms a preface to that major re-evaluation.

Marla No. 1, Manya No. 1 and Wallira West No. 1 penetrated only thin sequences of pre-Permian carbonates before drilling was terminated. Although sub-Arckaringa Basin carbonate sequences may be Devonian in age (as in Cootanoorina No. 1; Allchurch *et al.*, 1973), present consensus favours the association of carbonate sequences in these three wells with ?Cambrian Officer Basin sediments. For the purposes of this report they have been allotted a ?Cambrian age.

TABLE 1

WELL NAME	DATE SPUDDED	DATE COMPLETED	ORGANISATION	TOTAL DEPTH	THICKNESS OF PRE-PERMIAN
EMU 1	23.8.63	30.10.63	EXOIL	417.56 m	347.5 m
MANYA 1	10.9.74	23.9.74	S.A.D.M.E.	151.25 m	5.25 m
MARLA 1	28.9.74	5.10.74	S.A.D.M.E.	106.08 m	22.58 m
MUNYARAI 1	6.7.68	19.8.68	CONAUS, AUS.SUN, EXOIL & TRANSOIL	9 510 ft) 2 899 m)	1 328.9 m
MURNAROO 1	3.11.76	5.12.76	S.A.D.M.E.	627 m	582.5 m
WALLIRA WEST 1	14.3.71	24.3.71	S.A.D.M.E.	358.78 m	43.9 m
WILKINSON 1	5.6.78	9.8.78	S.A.D.M.E.	709.95 m	593.95 m

SUMMARY OF STRATIGRAPHIC WELLS DRILLED IN THE OFFICER BASIN.

METHOD OF STUDY

The techniques used in studying the sediments from each well are described below.

1. Cores and Cuttings

Cores and cuttings from each well featured in this report are stored at the SADME Core Library at Glenside. These were examined macroscopically and the rock type, colour, grainsize, sedimentary features, carbonate content and mineralisation were described and entered onto logs (Figs 4 to 10). Emu No. 1 and Wallira West No. 1 were re-described and logged by B.C. Youngs, and her basic data have been incorporated into this study.

2. Preparation of Stained Acetate Peels

Most carbonate units were sampled for preparation of stained acetate peels (taken from half-core sections) that were subsequently examined under a low-power microscope.

The carbonates were prepared for peeling by a method based on that described by Davies and Till (1968). Etching and staining times were adjusted to suit the varying carbonate types, and Alizarin red-S and potassium ferricyanide were used in staining. Peels were made using the cellulose acetate sheet method of Stewart and Taylor (1965).

Manya No. 1 and Marla No. 1 cores had acetate peels taken previously, and original descriptions are presented in Thornton (1975).

3. Thin Sections

Observations on cored material were supplemented by microscopic re-examination of thin sections cut by the Australian Mineral Development Laboratories (AMDEL), with some reference to their accompanying petrographic reports. Relevant thin-sections are identified on the logs in Figs. 4 to 10.

4. Trace Element Analyses

Numerous sulphide occurrences were noted in some cores; these were sampled and submitted for trace-element analyses to W.G. Shackleton of Salisbury College of Advanced Education and to AMDEL. The results of these analyses are to be reported under subsequent publications by the SADME Officer Basin Study Group.

Sulphides and base-metal geochemical anomalies recently were identified in SADME Wilkinson No. 1, and sulphides in SADME Murnaroo No. 1 (well completion reports in preparation). In Figure 10 are released for the first time results of previous geochemical analyses showing high base-metal contents in cuttings from CONOCO Munyarai No. 1.

BRIEF LITHOLOGICAL DESCRIPTIONS

Following are summaries of the examined sequences from each of the seven Officer Basin wells shown in Figure 2. More detailed information is provided on logs.

(i) Manya No. 1 (section studied: 146.0 m to 151.25 m)

SADME Manya No. 1 (Fig. 2) was drilled in September 1974 to investigate a high-speed seismic refractor, identified by Hall (1973) as a dense carbonate following seismic exploration of the northern part of the Wintinna Gravity High. Manya No. 1 (Fig. 4) penetrated 5.25 m of ?Early Palaeozoic carbonates beneath Permian rocks of the Arckaringa Basin (Thornton, 1975).

Description:

The 2.45 m core consists predominantly of dark grey dolomicrite with minor beds of pale green-grey micrite and pale grey dolomitic siltstone and shales. The dolomicrite is very hard and dense, with some intrasparite and ?pelsparite. Calcite veins are common and associated stylolites are present near the base of the core.

(ii) Marla No. 1 (section studied: 83.50 m to 106.08 m)

SADME Marla No. 1 is located 46 km north of Manya No. 1 (Fig. 2) in a region where a high-speed seismic refractor was interpreted to be an Early Palaeozoic sand-stone (Hall, 1973). This well penetrated 22.58 m of interbedded carbonate and siltstone with minor sandstone (Thornton, 1975), a sequence assumed to represent the high-speed seismic refractor.

Description:

Marla No. 1 (Fig. 5) penetrated a micrite and siltstone sequence with some minor sparite, biopelsparite and intramicrite. The cored sediments contain well preserved trilobite fragments (Plates 1 and 2) at 87.80-87.85 m depth and one stromatolite at 102.53-103.00 m depth. Well developed stylolites (Plate 3) and intraclastic micrite with stylolitic boundaries (Plate 4) are common throughout the cored section.

(iii) Wallira West No. 1 (section studied: 314.84 m to 358.73 m)

Wallira West No. 1 is a stratigraphic well drilled by the SADME in 1971. Its location was chosen from seismic work, to find the extent and thickness of Permian sediments in the southwestern Arckaringa Basin and to determine the nature of unknown high-speed seismic refractors (Milton, 1973; Townsend, 1971).

Wallira West No. 1 (Fig. 6) cored 9.15 m of a carbonate-shale-sandstone sequence below 314.84 m depth. This sequence may correlate with the ?Cambrian Observatory Hill Beds (Townsend, 1971).

Description:

This sequence consists of interbedded micrite, dolomicrite, shales and sandstones. The carbonate beds, some of which are eight metres thick, are predominantly pale and dark grey, fine to medium grained micrites. A seven metre thick pale to medium grey, cross bedded dolomicrite occurs between 355.68 m depth and the base of the sequence at 358.73 m depth. A pale brown and pale grey pyritic shale occurs between 320 m and 328.50 m depths and a stromatolitic layer is present in a micrite bed at 330.4 m depth (Plate 5).

(iv) Murnaroo No. 1 (section studied: 45 m to 627.5 m)

Murnaroo No. 1 was drilled by the SADME close to Observatory Hill near the assumed southeastern margin of the Officer Basin (well completion report in press), to test the westerly extent of the Arckaringa Basin and to identify seismic refractors (Milton, 1975).

Description:

Two major stratigraphic units were penetrated (Fig. 7):

(a) 45-317 m

This upper unit is an interbedded sequence of siltstones and dolomicrites. The siltstones are predominantly red-brown and green-grey, with minor interbeds of crystalline secondary dolomite (Plate 7). The major carbonate occurrence is an (approximately) 41 m thick bed, which can be subdivided into two sections. The upper section from 164 m to 181 m depth is a pink and grey dolomicrite, in which a distinctly vuggy sulphide-bearing interval occurs (166.9-180 m). The lower section is a dark and light grey petroliferous and sulphide-bearing micrite.

A folded algal mat occurs within a red-brown siltstone at 83.4 m depth (Plate 6).

(b) 317-627.5 m

This unit is composed of red and pale brown, fine to medium grained, feldspathic sandstone interbedded with siltstone. Beds frequently show heavy-mineral banding, graded bedding and clay clasts. This sandstone unit, of unknown total thickness, probably is part of an extensive but un-named stratigraphic unit in the southeastern Officer Basin (see Wilkinson No. 1, Emu No. 1: Figs 8 and 9).

(v) Wilkinson No. 1 (section studied 210.10 m to 710 m)

Wilkinson No. 1 (Fig. 2) was drilled by the SADME in June-August 1978, partly to identify the extent of the Officer Basin. It penetrated a 594 m section of ?Cambrian sediments possibly correlatable with the Observatory Hill Beds.

Within the studied section six main rock units were recognised (Fig. 8).

Description:

(a) 210.10 m to 265 m.

Red-brown, silty dolomicrite with minor lenses of green-grey micrite. The dolomicrite is identifiable by euhedral rhomboid crystals visible under high magnification. The green-grey micrite commonly bears sulphide as disseminated radially-structured blebs.

(b) 265 m to 335 m

This unit is predominantly a pale grey micrite with rare secondary dolomite and minor sandy beds. Gypsum veining is common: the elongate prismatic crystals and lack of staining are diagnostic features under the microscope (Plate 8).

This unit contains some rare ooids and peloids at 330 m depth (Plate 9), and some concentrically banded chalcedony (Plate 10).

(c) 335 m to 440 m

This unit is predominantly a red-brown, gypsiferous and silty dolomicrite similar to unit (a) but with numerous minor green-grey micritic interbeds. Sulphides occur at 390 m depth (Fig. 8) in a green-grey micrite.

(d) 440 m to 570 m

This is a sequence of interbedded silty red-brown and dark grey petroliferous carbonates. The interbeds are no thicker than 10 m and some are laminated. The interval contains two stromatolitic layers (Fig. 8) and bedding appears more disturbed towards the base.

Two minor sulphide occurrences were identified within and immediately below the stromatolites which occur at 463-465 m depth.

(e) 570 m to 695 m

Well bedded dark red-brown, mottled, ferruginous siltstones are thinly interbedded within massive halite beds. The halite is brown and translucent, and by chemical analyses is almost pure NaCl. About 1 m of dark grey petroliferous micrite occurs near the base of this unit.

(f) 695 m to 710 m

This interval consists of a red-brown fine to medium grained ferruginous sandstone that may correlate with sandstones penetrated in the lower portions of Emu No. 1 and Murnaroo No. 1.

(vi) Emu No. 1 (section studied: surface to 417.56 m)

Emu No. 1 was drilled in 1963 as a stratigraphic test by Exoil Pty. Ltd. It was the first well drilled in the Officer Basin and was intended to penetrate to basement, thus assisting the review and interpretation of geophysical work previously done by that company (Grasso, 1963). Of the 417.56 m drilled only 15 m were cored. By examination of cores and cuttings four main lithological units have been defined (Fig. 9).

Description:

(a) 0-58 m

Red and green micaceous sandstone with brown and grey siltstone interbeds.

(b) 58-168 m

From 58 m to 106 m depth brown and grey silty dolomicrites and micrites are interbedded with siltstone and green shale. The interval exhibits fine, wavy bedding and is pyritic throughout. From 106 m to 168 m depth a mainly green-grey micrite with thin cherty lenses occurs. The micrite shows laminated, wavy bedding that is occasionally disrupted as intraclasts. Small patches (1 to 2 mm) of postdepositional gypsum are common.

(c) 168-277 m

Brown, calcareous siltstone with minor micrite beds.

(d) 277-417.56 m

There are four main lithologies in this unit:

277-292 m Sandstone with siltstone and shale

292-322 m Carbonate, dolomitic, with siltstone

322-348 m Siltstone, non-calcareous, gypsiferous

348-417.56 m Sandstone.

(vii) Munyarai No. 1 (section studied: surface to 2926 m)

Munyarai No. 1 was drilled by Continental Oil Company of Australia Ltd. to test a large anticline mapped by geophysical methods.

Description:

Three broad lithological units were recognised from cores and cuttings (Fig. 10).

(a) 0 ft to 2 800 ft (0-835 m)

Red-brown and grey sandstone, siltstone and mudstone. Beds are generally uniform and undisturbed. Some possible spines and ?fishscales have been recognised in this sequence (Gilbert-Tomlinson, 1969).

(b) 2 800 ft to 5 025 ft (835 - 1 546 m)

Quartz sandstone with well rounded, clear grains. There are some red-brown interbeds of mudstone.

(c) 5 025 ft to 9 510 ft (1 546 - 2 926 m)

Green-grey calcareous shale with two carbonate beds:

(i) 7 100 ft to 7 250 ft (2 164 - 2 209.7 m)
Olive grey and brown grey, laminated micrite, bedding frequently cut by sub-vertical calcite veins.

(ii) 8 600 ft to 8 690 ft (2 621 - 2 649 m)
Interbedded carbonate and shales.

From shales below the lower carbonate, trace-element analyses recorded some high lead and zinc concentrations (Fig. 10).

DEPOSITIONAL MODEL

Study of the seven wells shows that the Munyarai No. 1 sequence represents a depositional regime different from that displayed by the other six well sections. Palaeontological and palynological evidence (Gilbert-Tomlinson, 1968; Vlierboom, 1973) shows the Munyarai No. 1 sequence to be of Devonian age, that is, significantly younger than the other six assumed ?Cambrian sequences.

Three of these latter six sequences correlate reasonably well with each other, and Emu No. 1 and Murnaroo No. 1 probably correlate with part of the Observatory Hill Beds outcrop (Murnaroo well completion report, in press). This outcrop appears to be Cambrian in age (Wopfner, 1969a), a suggestion supported by the discovery of one problematic

?Biconulites adjacent to the type section outcrops (Gatehouse, 1976).

The characteristic occurrence of chert nodules in both the Observatory Hill Beds type section and the Early Cambrian Andamooka Limestone (Wopfner, 1969b) at the Stuart Creek Agate Deposit (Crettenden and Barnes, 1978), about 37 km north-northwest of the Andamooka opal fields (Fig. 1), is further but tenuous evidence that the studied sections may be Early Cambrian in age.

Manya No. 1, Marla No. 1 and Wallira West No. 1 penetrated only thin ?Cambrian sections and are therefore difficult to correlate with the much thicker sections in the other three wells.

It appears by the present study that the ?Cambrian carbonates of the Officer Basin were deposited on a broad stable platform in a warm, shallow, low-energy marine environment close to a low-relief landmass.

This model, based on lithologic evidence from the six wells discussed, suggests that the studied area lay in the landward part of the 'Z' type hydraulic zone (Irwin, 1965).

Irwin (1965) defined the 'Z' zone as one of low-energy shallow waters, up to hundreds of kilometres wide, occurring on the landward side of the high-energy 'Y' zone. The 'Z' zone is characterised by a lack of water circulation, with tidal and wave action affecting the zone during local storm conditions. Although sedimentary facies from the studied wells fit into this broad definition, a more detailed system of zoning carbonate facies (Wilson, 1975) can be used to qualify this depositional model.

Wilson (1975) defined nine facies zones. I consider that sedimentary features found in the studied wells accord with his Zone Eight and possibly with Zone Nine.

Zone Eight is defined as "Facies of restricted circulation on a marine platform" and Zone Nine as "Platform evaporative facies". Characteristic features of Zone Eight include mostly light-coloured, fine grained sediments with coarser lenses from tidal channels and local beaches. Wilkinson No. 1, Emu No. 1 and Wallira West No. 1 sediments display examples of both graded and cross bedding probably originating from current action in shallow water. Wilson (1975) states that the depositional environment of Zone Eight is variable and the interbedded nature of the sediments from the six studied wells may reflect such conditions. Furthermore the general lack of fossils possibly results from a "stress environment" such as may be created in varying conditions of fresh, saline or hypersaline waters.

Wilson (1975) also suggested that in Zones Eight and Nine, during periods of marine regression, supratidal and inland pond environments may develop where salt could precipitate; the interbedded siltstone and salt sequence in Wilkinson No. 1 may have originated in this manner. Evidence of sub-aerial exposure, such as the mudcracks noted in several of the studied wells, also accords with both Zone Eight and Zone Nine environments, but sediments of the six wells studied show varying degrees of recrystallisation and dolomitisation. These diagenetic effects are characteristic of a Zone Eight environment.

It would appear that the postulated epeiric shelf of the Officer Basin region underwent cycles of marine and "less-marine" influence, since Emu No. 1, Murnaroo No. 1 and Wilkinson No. 1 show reasonably well defined carbonate and carbonate-siltstone cycles. During "more marine" periods the paler grey, fine grained and less clastic carbonates may have been deposited. Regressions may have resulted in an influx of detritus from an exposed landmass, leading to deposition of the red-brown calcareous siltstones and mudstones.

Marla No. 1, Manya No. 1 and Wallira West No. 1 penetrated only thin carbonate sequences, of an interbedded nature, and therefore are assigned to Zone Eight on only sparse evidence. However Marla No. 1 and Manya No. 1 contain some trilobite debris, possibly indicating proximity to an environment more favourable to fauna.

CONCLUSIONS AND RECOMMENDATIONS

Six of the seven wells studied penetrated carbonate sequences believed to correlate at least in part with the ?Cambrian Observatory Hill Beds. The six wells bear evidence to suggest that the carbonate sequences were deposited in a warm, shallow, low energy marine environment. The seventh well, Munyarai No. 1, drilled rocks no older than Devonian in age.

Most of the ?Cambrian carbonate facies show extensive dolomitisation and recrystallisation, that perhaps created zones of secondary porosity. Together with the recognition of encouraging source-rocks this warrants further exploratory work, preferably by fully-cored wells.

ACKNOWLEDGEMENTS

I wish to thank the Fossil Fuels Division for useful discussions during the compilation of this report, especially Miss B.C Youngs for her valuable tuition in carbonate petrography and Don Vinall for the preparation of acetate peels.

A.J. LYDYARD

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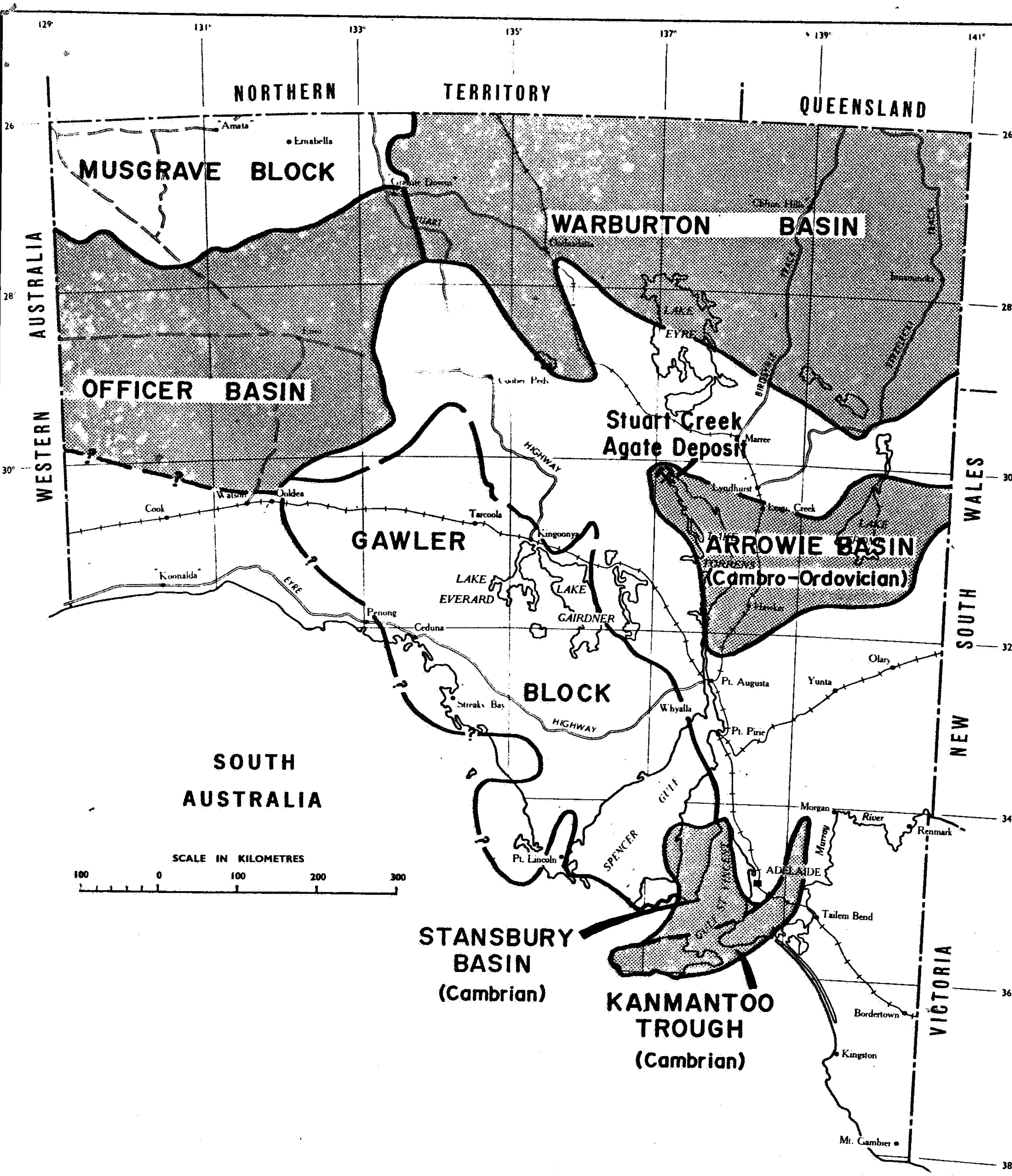


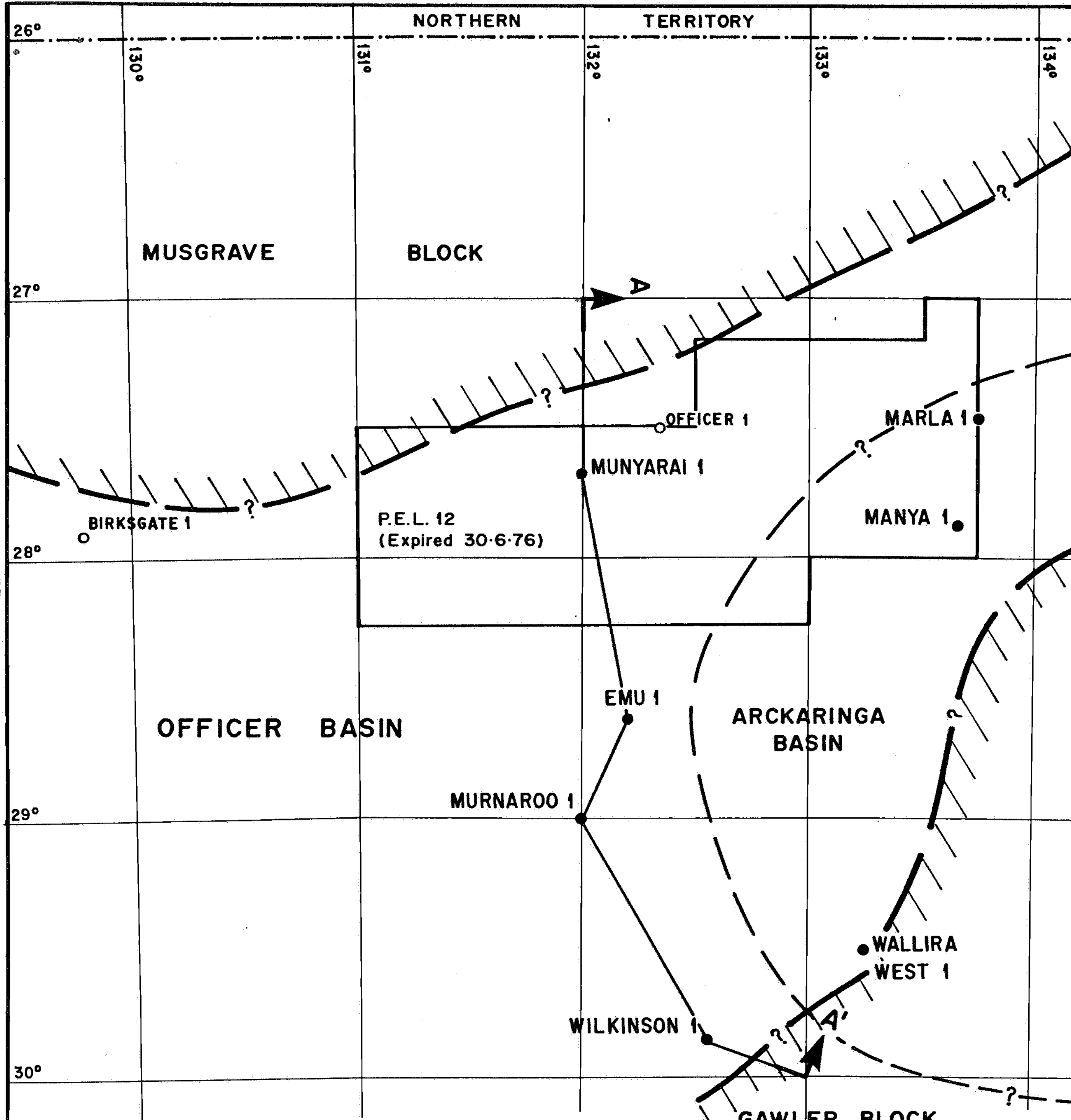
After Wopfner, 1972.

FIG 1.

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Compiled. A. Lydyard.	CAMBRO–DEVONIAN BASINS OF SOUTH AUSTRALIA	Date: 27-2-79
Drn. G.J.T. Ckd		Drg. No. S13904

P.F. No. S585C 994.2



● Wells studied.

○ Other wells.

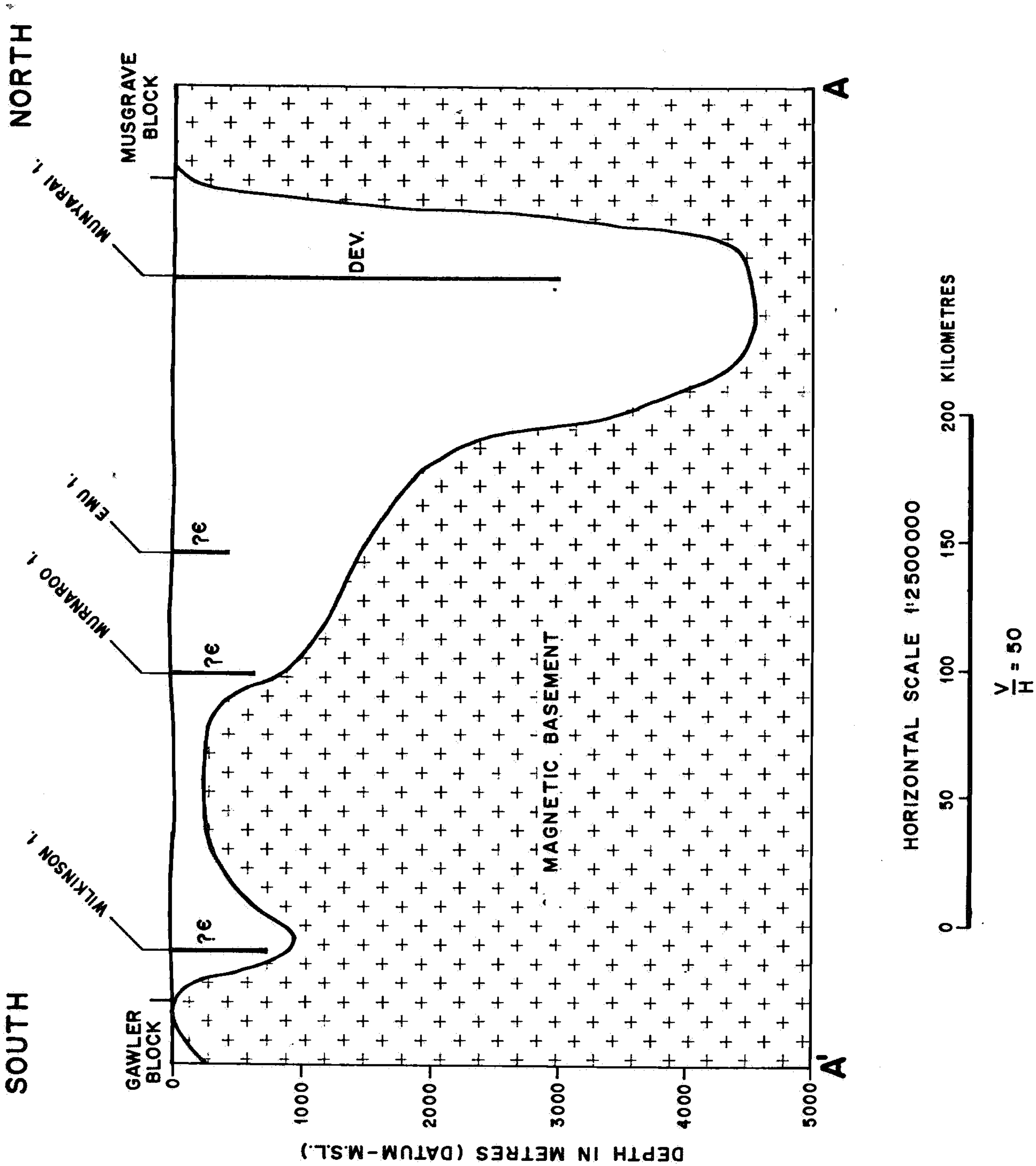
A — A' Cross-section. (see plan S13906), Fig 3.

SCALE 1:2 500 000

KILOMETRES 50 0 50 100 150 200 250 KILOMETRES

FIG 2.

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1:2 500 000
COMPILED A.Lydyard	OFFICER BASIN	DATE 28-2-79
DRN G.J.T. CKD	WELL LOCATIONS	PLAN NUMBER S13905



For location of section see plan S13905, fig 2

NOTE—Taken from unpublished S.A.D.M.E. data.

FIG 3.

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: As Shown
COMPILED: A. Lydyard	OFFICER BASIN	DATE: 28-2-79
DRN G.J.T. | CKD	CROSS-SECTION SHOWING INTERPRETED DEPTHS TO MAGNETIC BASEMENT	PLAN NUMBER S13906

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

FOSSIL FUELS DIVISION

PLAN NUMBER S13917

MANYA No.1. WELL

COMPILED: A.LYDYARD | DRAWN: G.J.THORPE | DATE: 14-3-79

DOLOMITE

? TRILOBITE FRAGMENTS

DEPTH in metres	SUMMARY LITHOLOG	ACETATE PEELS	THIN SECTIONS	KNOWN MINERALIZATION	PREDOMINANT CARBONATE COLOURS: DARK GREY				PALAEONTOLOGY	LAMINITES	LITHOLOGIC DESCRIPTIONS
140											*BOORTHANNA FORMATION*
145											*BASE OF PERMIAN*
146.00	Core Lost.										
150									✓		*DOLOMITE and CALCITE MICRITE; minor pelsparite & intramicrite, dark grey & minor brown-grey. Stylolitic towards base. Possible trilobite fragments. Recrystallisation throughout. Becomes vuggy towards base.*
155											*END OF HOLE 151·25 m.*

FIG. 4.

1221

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

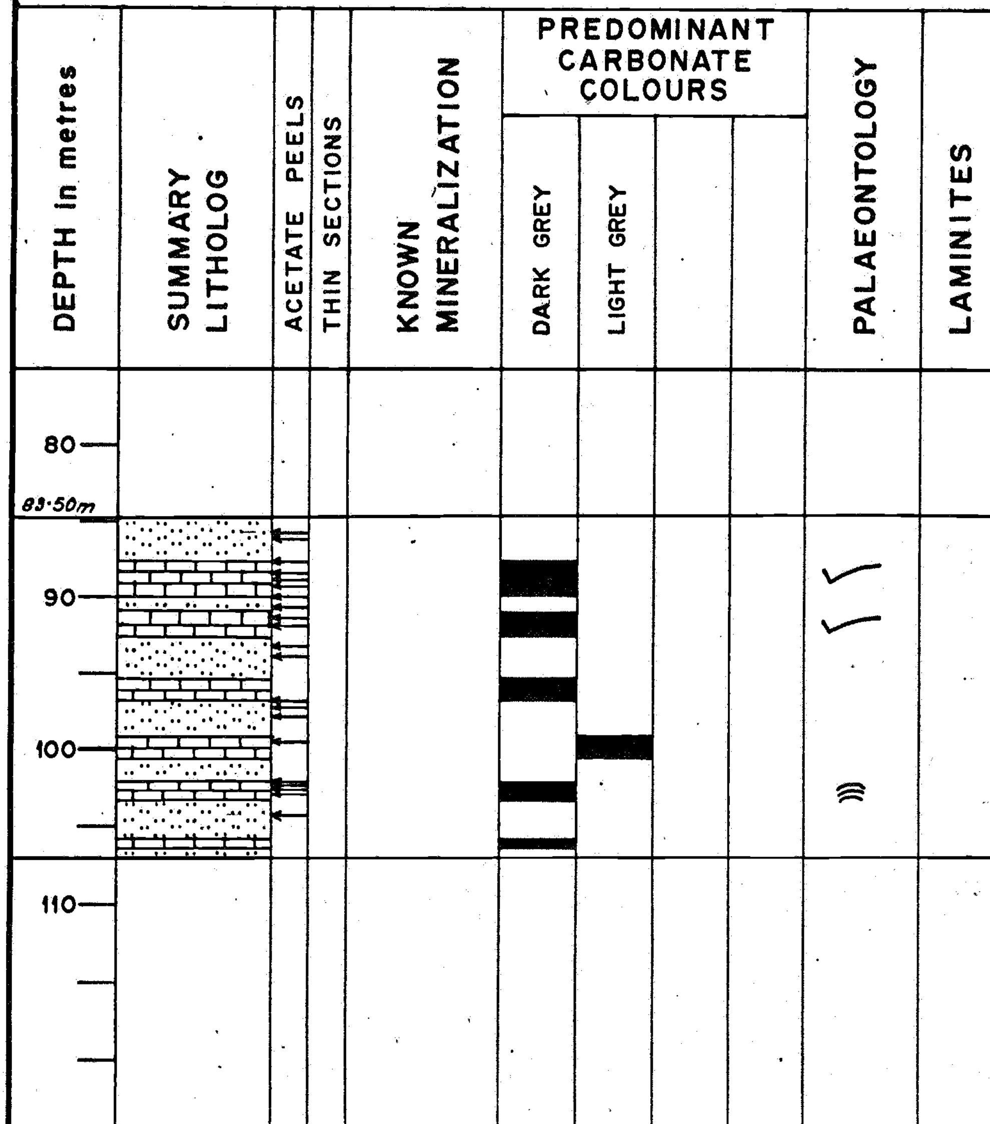
SUMMARY OF GEOLOGICAL DATA

FOSSIL FUELS DIVISION

PLAN NUMBER S13916

MARLA No. 1. WELL

COMPILED: A. LYDYARD. | DRAWN: G.J. THORPE. | DATE: 6-3-79



SILTSTONE, SHALE & SANDSTONE.

CARBONATE.

? TRILOBITE FRAGMENTS

STROMATOLITES

LITHOLOGIC DESCRIPTIONS

PERMIAN – BOORTHANNA FORMATION

Interbedded siltstone, shale & sandstone. Calcareous. Light brown-yellow greys. Graded bedding and stylolites.

Sparite, biopelsparite, micrite. Predominantly dark grey. Trilobite remains 87·8–87·9m. Stylolites and cavities infilled by calcite pellets and a few ooids evident.

Shale and siltstone. Yellow and grey, some coarser sand lenses.

Micrite, Dark grey, trilobite remains, stylolites, pellets, small chert nodules.

Interbedded shale and siltstone. Pink, mauve, yellows and pale browns. Stylolitic and calcite infilling cracks. Some coarser sandstone lenses.

Micrite. Dark grey, intramicrite with many stylolites.

Siltstone. Yellow, brown & purple. Some coarser grained sandstone lenses.

Carbonate, light grey, pelsparite, sparite & micrite, chert nodules & stylolites.

Interbedded siltstone, shale and sandstone as above

Carbonate, dark grey, oosparite, microspar, pelsparite & sparite. Some stromatolites.

Interbedded shale, siltstone & sandstone. As above.

Micrite, dark grey, dense.

Clay, light brown, and thin red sandstone.

TOTAL DEPTH 106·08 metres.

No 1221

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

FOSSIL FUELS DIVISION

PLAN NUMBER 79-253

WALLIRA WEST 1 WELL

COMPILED: B.C.YOUNGS. | DRAWN: G.J. THORPE | DATE: 16-3-79

DEPTH in metres | SUMMARY LITHOLOG | ACETATE PEELS | THIN SECTIONS | KNOWN MINERALIZATION | PREDOMINANT CARBONATE COLOURS: PALE GREY, MEDIUM GREY, DARK GREY, BROWN | PALAEONTOLOGY | LAMINITES

CARBONATE – CALCITE

CALCAREOUS SILTSTONE AND SHALE.

NON-CALCAREOUS SILTSTONE AND SHALE

DOLOMITE

STROMATOLITE / ALGAL MAT.

LITHOLOGIC DESCRIPTIONS

PERMIAN–BOORTHANNA FORMATION to 314·84m

325

Trace pyrite

CARBONATE; brown-grey, fine-grained with SHALE, pale to medium grey. Trace of fine grained SANDSTONE.

SHALE; pale-brown & pale grey-green, slightly calcareous, with minor CARBONATE, dark brown & grey. Traces of red SANDSTONE & IRON-PYRITES & ?CHALCOPYRITES.

MICRITE; medium-dark grey, calcite laminated bedding, intraclastic, recrystallised gypsum patches. Interbedded with SILTSTONE, ferroan, channelled. Algal mats, stromatolites. Vuggy at 332·40m.

SHALE; as above.

MICRITE; pale-medium grey (some brown), calcite, intraclastic. Chert nodules and beds, secondary gypsum veins. Rare iron-dolomite replacement in patches. SILTSTONE brown, lensing, channelled.

350

CARBONATE; pale grey (rare dark grey), interbedded with SANDSTONE, brown, medium grained with some ? basement grains (green & red) & SHALE, black.

DOLOMICRITE; ferroan, pale-medium grey, micrite, wavy bedding, x-beds, ?rippled ? burrowed. Rare minor SILTSTONE.

END OF HOLE 358·78m.

Core 6 : 329·78 – 332·83m

Core 7 : 341·97 – 345·02m

Core 8 : 355·68 – 358·73m.

375

FIG 6

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DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

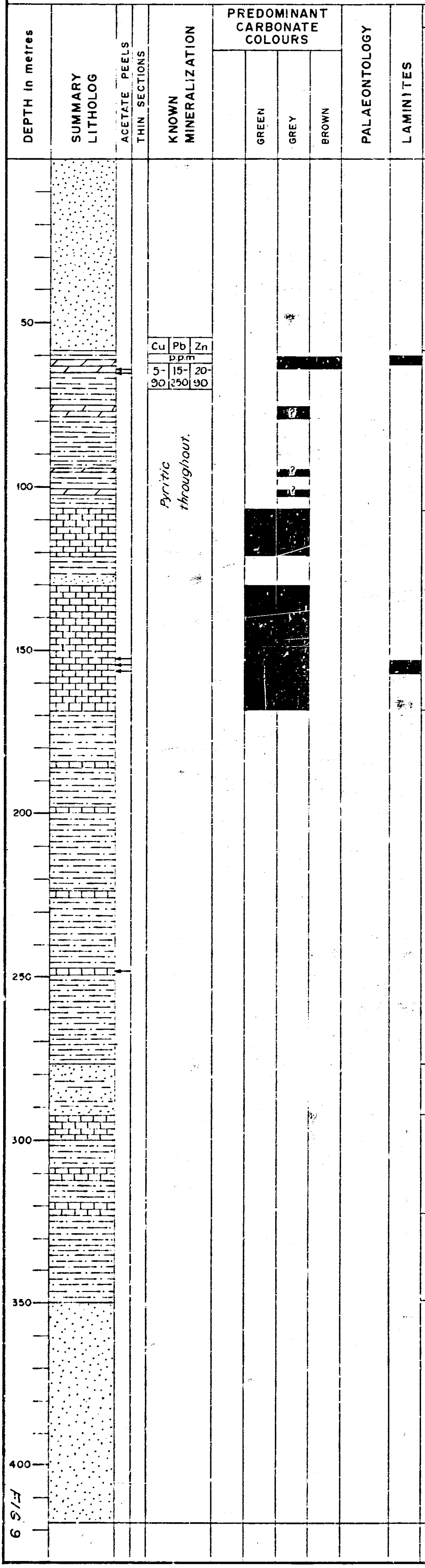
FOSSIL FUELS DIVISION

PLAN NUMBER 79-222

EMU No. 1 WELL

COMPILED: B.C. YOUNGS	DRAWN: G.J. THORPE	DATE: 8-3-79

Legend: SANDSTONE · SILTSTONE · SHALE · MICRITE · DOLOMICRITE



LITHOLOGIC DESCRIPTIONS

SANDSTONE; brown and green, micaceous, non-calcareous, with some siltstone interbeds.

DOLOMICRITE and MICRITE; brown and grey, silty, laminated at top, disrupted bedding. Interbedded in SILTSTONE, green, grey and red, and SHALE, green, pyritic throughout. Wavy, fine beds at top becoming massive downwards.

MICRITE; grey-green, flat laminated, wavy and some disrupted bedding. Slight ferroan-calcite. Few intraclasts. Small patches of gypsum (1-2mm). Rare opaques, red mottling. Chert lenses.

SILTSTONE; brown and green-grey, micaceous, calcareous. Rare green silty, slight ferroan-calcite MICRITE beds.

SANDSTONE; brown, calcareous, micaceous with SILTSTONE + SHALE.

CARBONATE; ?dolomitic and SILTSTONE, calcareous.

SILTSTONE; red brown, gypsum vugs + veins up to 50mm, non calcareous. Rare green mottles, ? burrowed

SANDSTONE; brown, subrounded grains, medium-course. ? Heavy mineral bands.

END OF HOLE 417.56m.

Fig 6

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

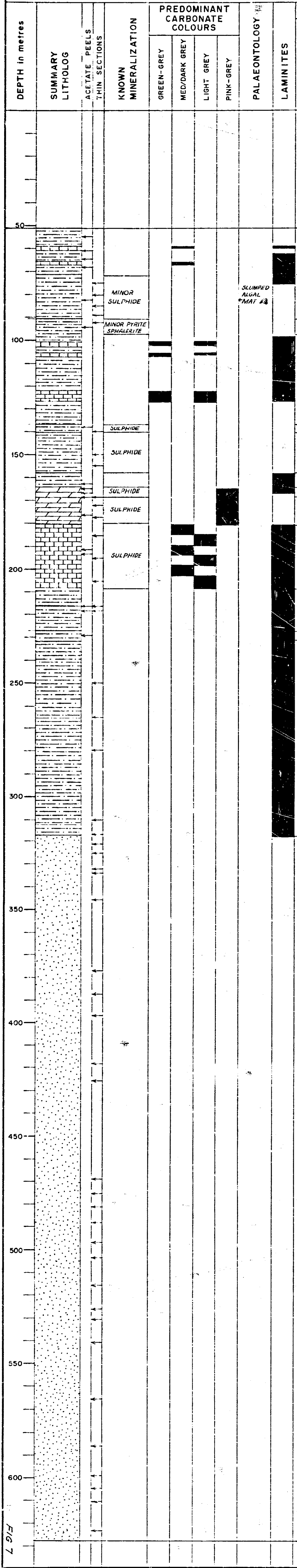
FOSSIL FUELS DIVISION

PLAN NUMBER 79-221

MURNAROO No.1. WELL

COMPILED: A. LYDYARD | DRAWN: G.J.THORPE | DATE: 12-3-79

SILTSTONE — SANDSTONE — INTERBEDDED SILTSTONE AND CARBONATE — MICRITE — DOLOMITE — STROMATOLITE



LITHOLOGIC DESCRIPTIONS

FULLY CORED SEQUENCE

Top of section 51·70m

SILTSTONE; calcareous, predominantly grey, green, white and purple beds, horizontal, distorted bedding in places. Interbeds of purer carbonate. Intraclastic intraclastic in places. Some cherty intraclasts.

SILTSTONE; mottled red-brown, fine grained. Feldspathic and ferruginous, minor gypsum. Predominantly detrital feldspar, quartz, mica. Fairly disturbed bedding.

SILTSTONE, pale grey, fine grained, laminated, numerous calcite veins.

SILTSTONE; mottled red brown, some minor dark green-grey and light grey carbonate beds and coarser, well sorted quartz and feldspar sandstones.

SILTSTONE; green-grey, slightly calcareous.

SILTSTONE; interbedded red and grey, calcareous, disrupted bedding.

SILTSTONE; grey, laminated.

DOLOMICRITE; pink and grey, very hard.

DOLOMICRITE; pink and grey. Dolomite crystals lining vugs. Sulphide occurs as disseminated blebs and veins.

MICRITE; alternating light and dark grey bands. Stylolitic and petroliferous. Sulphide as disseminated blebs towards top of unit.

SILTSTONE; green grey, minor calcareous lenses. Zone of ?glauconite-rich pebble conglomerate

SILTSTONE; mottled red-brown.

SILTSTONE; green-grey, minor light grey calcareous lenses.

SILTSTONE; red-brown and green-grey. Laminated bedding. Non calcareous.

SANDSTONE INTERBEDDED WITH SILTSTONE; predominantly red-brown and pale brown. Ferruginous and feldspathic quartz sandstones, frequently micaceous and heavy mineral-rich. Beds frequently show dark banding, graded bedding and clay clasts.

HEAVY MINERALS IDENTIFIED: tourmaline and zircon.

END OF HOLE 627·5m

FIG 7

79/1221

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

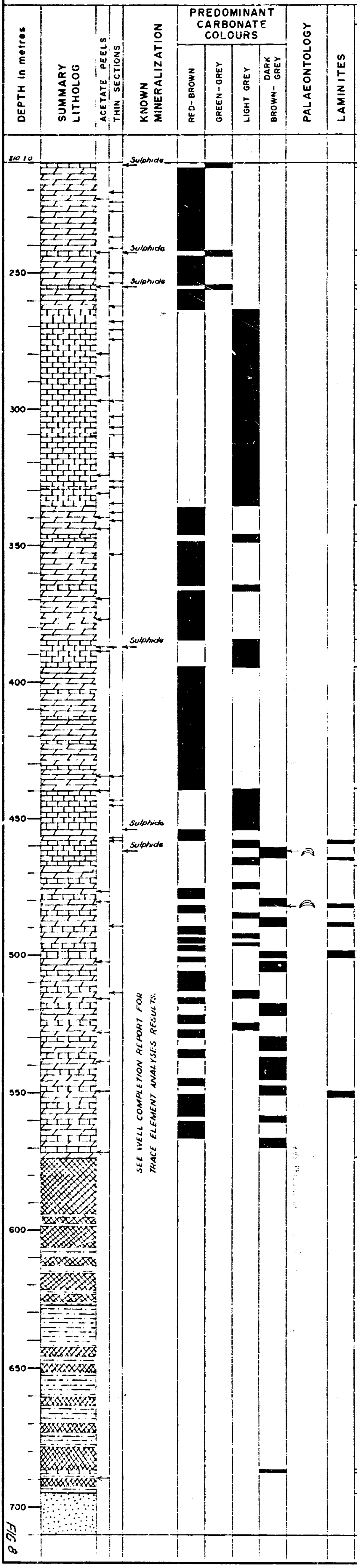
FOSSIL FUELS DIVISION

PLAN NUMBER 79-220

WILKINSON No. 1. WELL

COMPILED: A. LYDYARD | DRAWN: G.J.THORPE | DATE: 7-3-79

SILTSTONE — SANDSTONE — DOLOMICRITE — HALITE — MICRITE — INTERBEDDED HALITE AND SILTSTONE. — STROMATOLITES



LITHOLOGIC DESCRIPTIONS

FULLY CORED SEQUENCE

MICRITE; green-gray, sandy, sulphide bearing.

DOLOMICRITE; red-brown, silty, some minor pale yellow sandy beds, sand grains well rounded.

MICRITE; green-grey, sulphide bearing.

DOLOMICRITE; as above.

MICRITE; green-grey, sulphide bearing.

DOLOMICRITE; red-brown, silty.

MICRITE; pale grey, gypsiferous, minor dolomicrite beds, generally undisturbed. Some ooids and peloids at 330m.

DOLOMICRITE; red-brown, with some minor grey micrite beds. Dolomicrite is silty and shows slump structures, graded bedding and courser sandy beds.

MICRITE, pale grey, some ooids and peloids. Gypsum veining.

DOLOMICRITE; red brown, with minor grey micrite beds.

MICRITE

DOLOMICRITE; as above

MICRITE; interbedded dark grey and light grey. Sulphide bearing at 391m.

DOLOMICRITE; red-brow interbedded with grey micrite. Shows cross-bedding, graded-bedding, and some coarser intraclastic zones. MICRITE is often gypsiferous. Grains of fresh feldspar and mica are evident in thin section

MICRITE; pale grey with some recrystallized ooids.

DOLOMICRITE; red-brown.

MICRITE; pale grey-brown grey, some laminar bedding, secondary calcite, stromatolitic. Sulphide bearing.

DOLOMICRITE; interbedded with micrite. Micrite beds are dark grey, laminated and contain ?stromatolites at 481m.

MICRITE; finely laminated.

DOLOMICRITE-MICRITE interbeds continued. Micrites have ooids, post depositional calcite and gypsum veins. Some dark petroliferous vuggy sandy micrite.

HALITE; (98% NaCl). Brown, translucent, interbedded with red-brown siltstone.

MICRITE; dark grey, petroliferous.

HALITE.

SANDSTONE; red-brown, fine to medium grained, ferruginous.

END OF HOLE 709·95 metres.

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DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

SUMMARY OF GEOLOGICAL DATA

FOSSIL FUELS DIVISION

PLAN NUMBER 79-219

MUNYARAI No.1. WELL

COMPILED: A. LYDYARD | DRAWN: G.J.THORPE | DATE: 13-3-79

Columns: DEPTH in metres | SUMMARY LITHOLOG | ACETATE PEELS | THIN SECTIONS | KNOWN MINERALIZATION | PREDOMINANT CARBONATE COLOURS: BROWN-GREY, GREEN-GREY, DARK-GREY | PALAEONTOLOGY | LAMINITES | LITHOLOGIC DESCRIPTIONS

Legend: CARBONATE; SHALE; SILTSTONE, SANDSTONE & MUDSTONE; SANDSTONE

Depth scale: 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600, 2800

LITHOLOGIC DESCRIPTIONS

SANDSTONE, SILTSTONE and MUDSTONE.

Core no 1 — Cut 3·66m. recovered 1·22m. Sandstone and mudstone, red-brown and greyish white. Calcareous in places.

Core no 2 — Cut 4·57m. recovered 2·74m. Interlaminated sandstone and mudstone. Light grey and red-brown.

Core no 3 — Cut 3·05m. recovered 2·74m. Sandstone and shale, light grey and black. Slightly calcareous shale.

Palaeontology: Lenticular quartz?; Foraminifera?

Core no 4 — Cut 3·05m. recovered 3·05m. Interbedded sandstone and mudstone Chocolate and reddish brown, tan + dark green grey. Well laminated.

Core no 5 — Cut 6·10m. recovered 5·79m. Quartz sandstone, light to dark. Well cemented, low porosity. Clear quartz grains, medium to fine grained.

SANDSTONE.

Core no 6 — Cut 5·18m. recovered 4·34m. Sandstone, light, red and dark brown, fine to medium grained.

Core no 7 — Cut 3·05m. recovered 2·80m. Sandstone and mudstone, multicoloured predominantly brown, micaceous.

SHALE.

Core no 8 — Cut 3·96m. recovered 3·96m. Shale, dark grey and dark brown, thinly laminated.

Known mineralization: PYRITE

Palaeontology: UPPER DEVONIAN SPORES

Core no 9 — Cut 3·05m. recovered 3·05m. Shale, dark grey, calcareous. Laminae due to slight crystal size variation. Crystalline calcite in veins.

SILTY MICRITE, olive grey + brown-grey, microcrystalline.

Palaeontology: STRATIGRAPHY POINT TO NOT OLDER THAN WENLOCKIAN

Core no 10 — Cut 3·35m. recovered 0·26m. Micritic carbonate, even grained, dark grey to grey black. Laminated, calcite veins.

SHALE

Core no 11 — Cut 3·05m. recovered 3·05m. Shale, dark green, grey, calcareous. Laminated, sub-vertical calcite veins.

SHALE, calcareous in places

Core no 12 — Cut 3·05m. recovered 3·05m. Shale, green grey, calcareous.

Core no 13 — Cut 3·05m. recovered 3·05m. grey, calcareous.

Cu	Pb	Zn
ppm		
40	25	160
40	210	1500

Palaeontology: ASSEMBLAGE SUGGESTS MIDDLE TO UPPER DEVONIAN

Core no 14 — Cut 3·05m. recovered 2·57m. Shale grading to impure limestone. Medium-dark grey to dark grey

LIMESTONE + SHALE, brown grey, hard, fissile, light yellow fluorescence.

SHALE.

Shows at 2700m

Cu	Pb	Zn
ppm		
30	50	120
50	1100	3300
150	95	230
30	140	210
40	65	230
30	65	95
35	35	140
50	60	240
35	25	180
30	30	170
30	45	140
35	50	120
35	55	140
35	40	180
25	30	100
40	740	3100
25	150	550
30	90	330
40	50	160
100	50	160
35	75	200
30	35	120
85	60	160
35	25	120
25	25	75

Palaeontology: ASSEMBLAGE OF SPORES SUGGESTS LOWER-MIDDLE DEVONIAN

Core no 15 — Cut 3·05m. recovered 3·05m. Shale, medium to dark grey, pyrite. Calcite veins, non calcareous.

Palaeontology: woody Fragment

Core no 16 — Cut 3·05m. recovered 3·05m. Shale, highly micaceous, dark grey, calcareous, numerous laminae.

END OF HOLE 2926m.

FIG 10

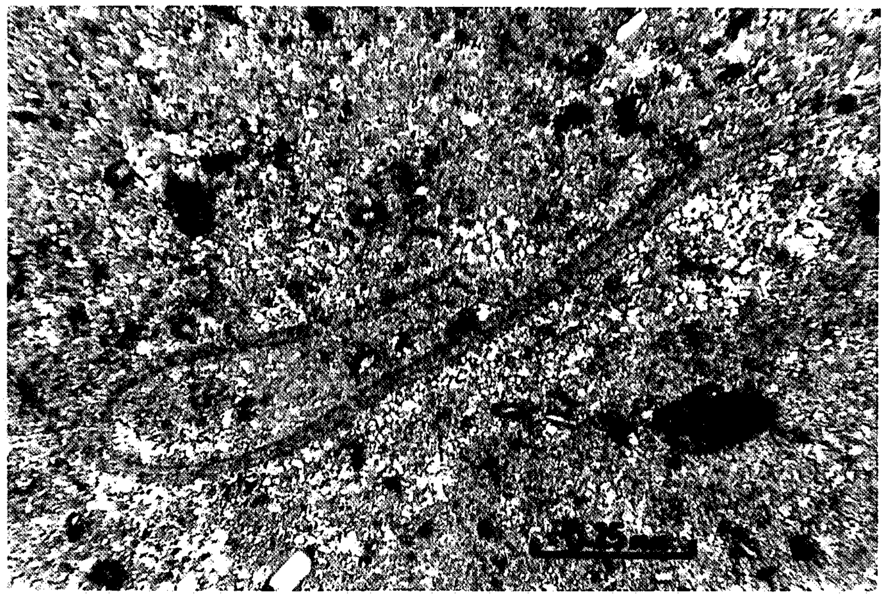

Plate 1. Trilobite hook in partially recrystallised micrite.
Marla No. 1, 87.80 m
(From acetate peel).

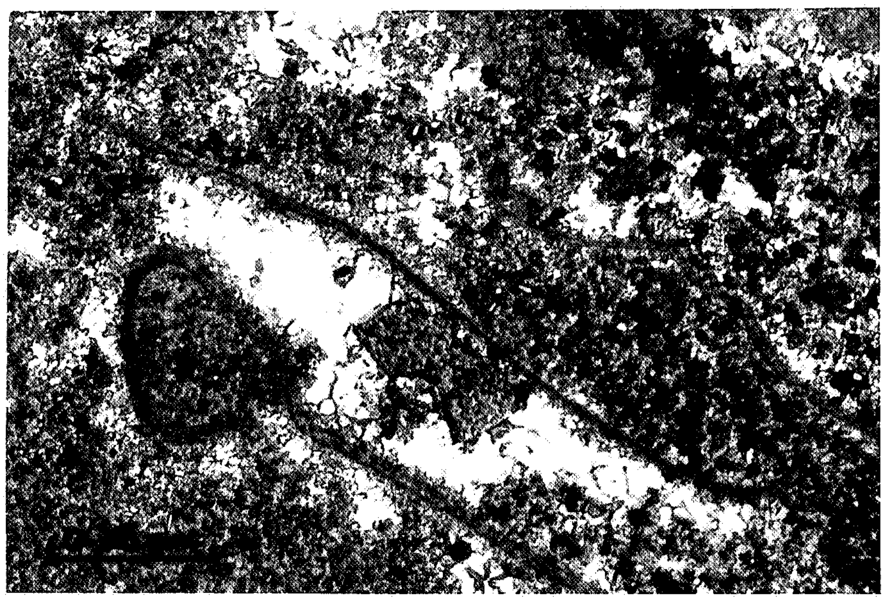

Plate 2. Trilobite fragments in micrite; note secondary sparry calcite between the fragments.
Marla No. 1, 87.80 m
(From acetate peel).

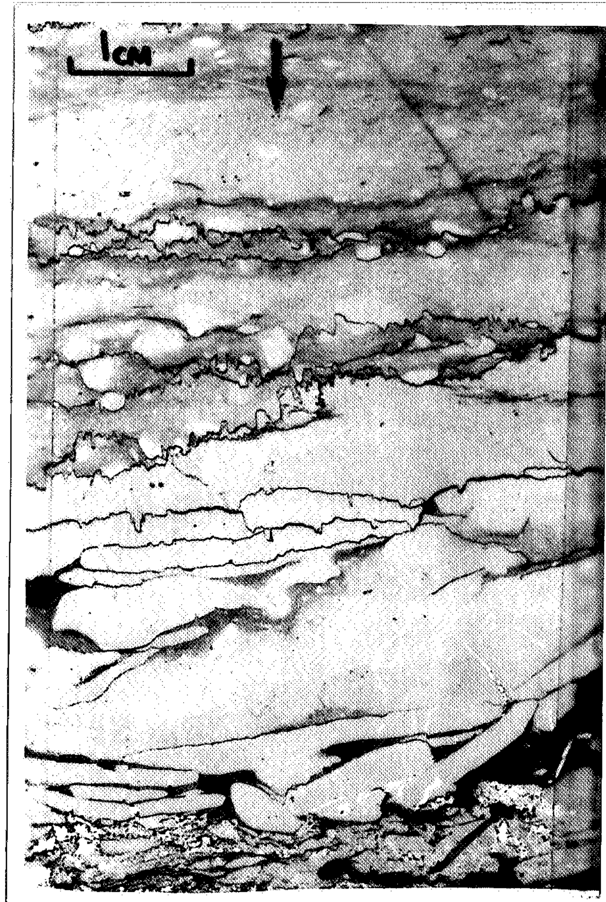

Plate 3. Stylolites in micrite; note dark (silty) traces.
Marla No. 1, 96.20 m
(From acetate peel).

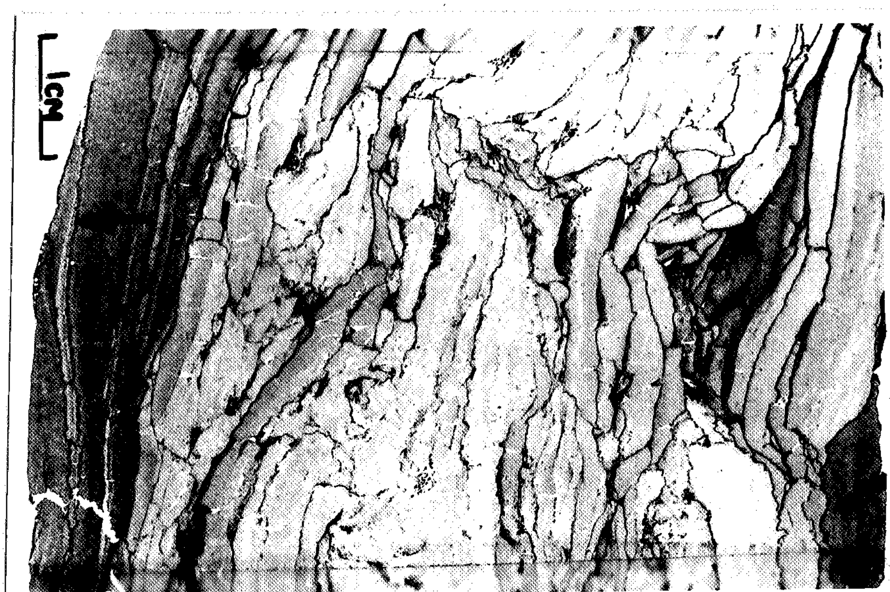

Plate 4. Finely bedded, disturbed micrite with stylolitic boundaries to intraclasts.
Marla No. 1, 96.20 m
(From acetate peel).

Plate 5. Algal mat or stromatolite underlain by silty beds.
Note chert nodule at bottom of plate.
Wallira West No. 1, 1083 ft. (330.4 m)
(From acetate peel).

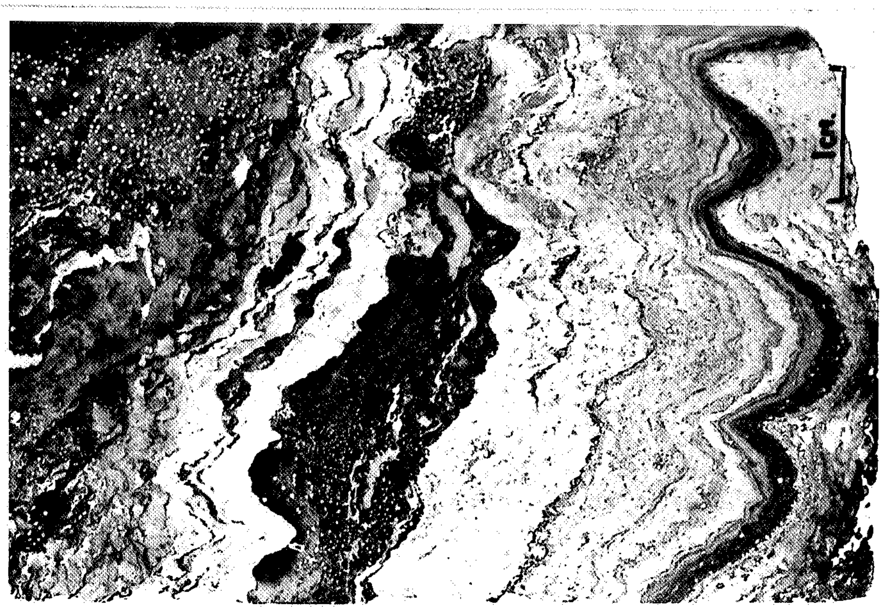

Plate 6. Folded algal mat in siltstone.
Murnaroo No. 1, 83.4 m
(From acetate peel).

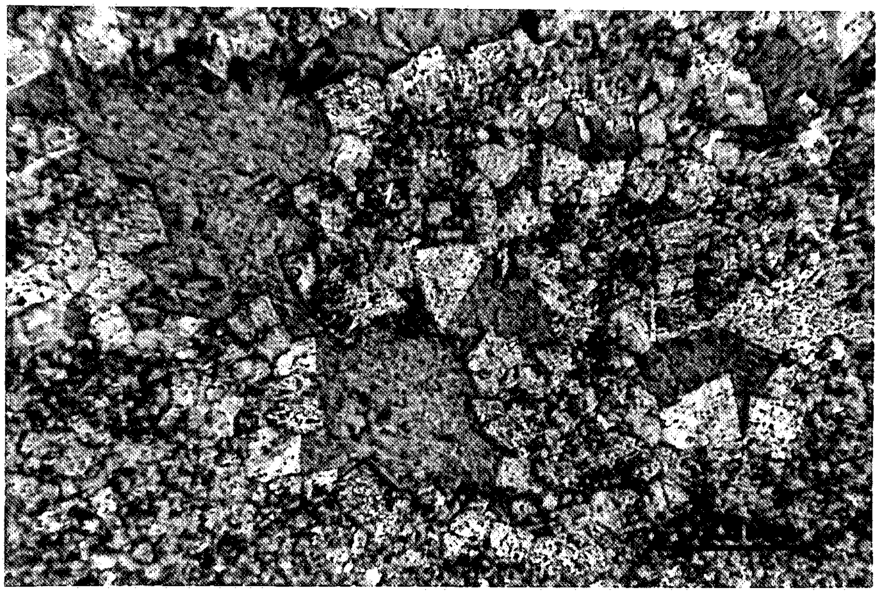

Plate 7. Rhombohedral dolomite crystals in a silty dolomite.
Murnaroo No. 1, 167.9 m
(From thin section).

Plate 8. Elongate secondary gypsum crystals in vein.
Wilkinson No. 1, 326.7 m
(From acetate peel).

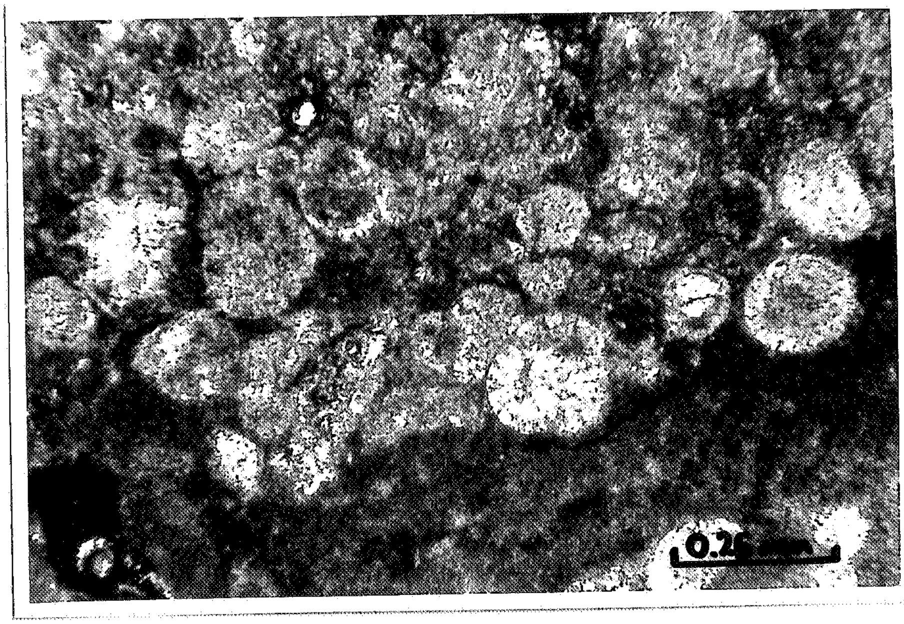

Plate 9. Spherical recrystallised ooids in a fine grained, silty dolomicrite.
Wilkinson No. 1, 516.12 m
(From thin section).

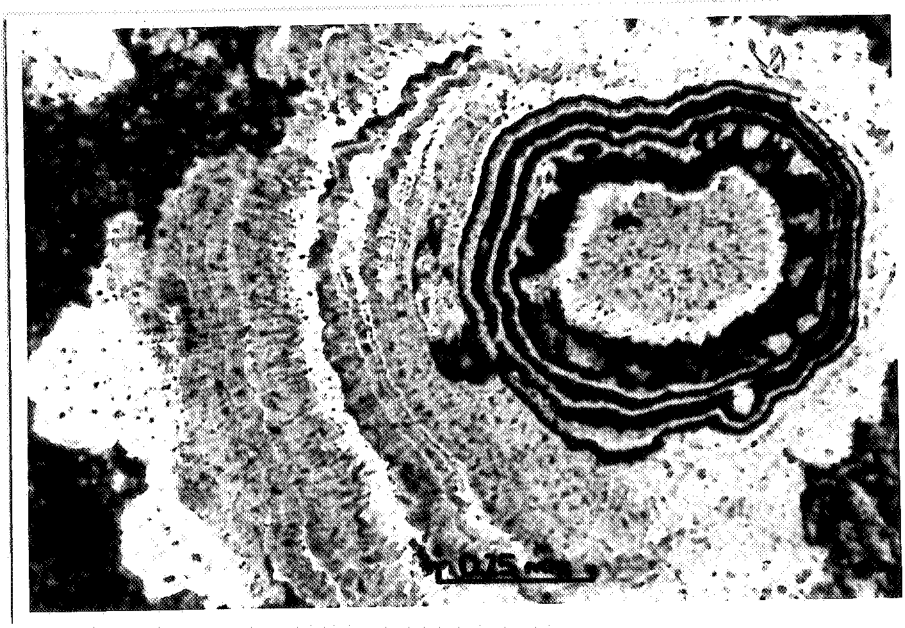

Plate 10. Concentric growth patterns of secondary chalcedony in micrite.
Wilkinson No. 1, 344.0 m
(From thin section).