DEPARTMENT OF MINES AND ENERGY
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COAL EXPLORATION DRILLING IN THE CLAYTON AREA, MARREE

GEOLOGICAL SURVEY

by

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CONTENTS PAGE

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ABSTRACT

A drilling programme and a review of existing geological data were undertaken to assess the potential for coal deposits in the Late Cretaceous Winton Formation in the Clayton area.

Four boreholes, totalling 140 m of HQ core drilling and 373 m of open-hole drilling using rotary-mud drilling techniques were completed in July 1985 without discovering any prospective occurrence of coal.

Borehole Clayton-3 was cored to a depth of 150 m to provide stratigraphic information. It intersected a sequence of Quaternary, Tertiary and Cretaceous sediments, the later being represented by the Winton and Mackunda Formations and possibly the Oodnadatta Formation. Three additional exploratory boreholes (CA1, CA2 and CA3) were drilled to test the extent and nature of coal seams in the Winton Formation and discovered only thin stringers of coal in borehole CA3.

The coal seams intersected in the Winton Formation are considered unprospective due to their thin and discontinuous nature.

INTRODUCTION

The investigation was instigated to assess the potential for coal deposits in the Late Cretaceous Winton Formation in the Clayton area of the southwestern portion of the Eromanga Basin (Figure 1).

The area selected covers the southern-most occurrence of Winton Formation in South Australia and is in close proximity to the Marree railhead, which would provide a direct rail link with the coal combustion power stations at Port Augusta.

The Winton Formation is a fluviatile sequence of siltstone, sandstones and mudstones with minor coal. Near the South Australian border in the Queensland portion of the Eromanga Basin, coal seams up to 7.6 m thick have been recorded in the lower part of the Winton Formation at a depth of about 600 m in petroleum exploration well Tallalia-1 (Gray, 1975). In the Clayton Area, there are reported intersections of coal and carbonaceous sediments in waterbores drilled through the Winton Formation at much shallower depths of between 50 and 100 m, with potential for shallower coal occurrence.

Currently available information on the distribution of the Winton Formation and coal seam thickness and quality is inadequate to enable a realistic assessment of the area's coal potential. Consequently a drilling programme was planned to drill four boreholes to obtain stratigraphic information and test the nature of coal occurrences previously reported.

The drilling results and a review of existing data for the area are presented in this report.

LOCATION

The Clayton area covers the southwestern portion of the MARREE 1:250 000 map sheet and the northeastern portion of the CURDIMURKA 1:250 000 map sheet. It is approximately 50 km north of Marree and can be accessed via the Birdsville Track and along minor station tracks belonging to the Clayton, Muloorina and Dulkaninna pastoral properties (Figure 2).

The Clayton River, a major ephemeral creek, flows in a north-westerly direction through the centre of the area and drains into the southern portion of Lake Eyre.

REGIONAL STRATIGRAPHY

Cretaceous

The Clayton area is situated near the southwestern margin of the Eromanga Basin and the stratigraphy and problems concerning stratigraphic nomenclature for the Mesozoic of this area are discussed in reports by Forbes (1982) and Moore & Pitt (1982).

Petroleum explorers in the South Australian and Queensland portions of the Eromanga Basin have defined in the subsurface a sandy sequence overlying the Oodnadatta Formation which has been subdivided into two units corresponding to the Winton and Mackunda Formations. To date, this subdivision has not been applied to outcrop nomenclature in the southwestern Eromanga Basin, although recent studies by Krieg (in press) and Forbes (1982) have indicated that a differentiation is possible.

The Cretaceous nomenclature preferred in this report is that of Moore and Pitt (1985), shown in Figure 3, and of particular interest are the youngest sediments comprising the Winton and Mackunda Formations.

The Early Cretaceous (Albian) Mackunda Formation lies conformably on the Oodnadatta Formation, and is overlain conformably by Winton Formation. It consists of interbedded fine sandstone, siltstone and mudstone and is slightly calcareous near the base. The Formation averages 60 m in thickness in the Central Eromanga Basin (Senior et al., 1978) and thickens to about 100 m in the southwestern Eromanga Basin (Moore & Pitt, 1982). The environment of deposition is interpreted as marginal-marine to paralic with deposition along a low-energy shoreline in response to a regression of the sea (Exon and Senior 1976).

The youngest Cretaceous unit is the Late Cretaceous Winton Formation, which is a non-marine sequence of siltstone, sandstone and mudstone with minor coal interbeds. It rests conformably on the Mackunda Formation and is unconformably overlain by Tertiary and Quaternary deposits. The distribution and thickness of the Winton Formation is controlled by the combined effects of Late Cretaceous subsidence and subsequent Tertiary erosion. It attains a maximum thickness of 1 200 m in the centre of the basin and thins towards the margin. The Winton Formation is regarded as a fresh-water sequence deposited on a broad coastal plain as the sea regressed (Exon and Senior 1976).

Tertiary and Quaternary

The Tertiary and Quaternary cover in the Marree region consists of non-marine sediments of the Lake Eyre Basin.

Overlying the prospective Winton Formation are fluviatile sands of the Eyre Formation (Palaeocene-Eocene) and lacustrine sediments of the Miocene Etadunna Formation (Callen, 1983).

The Quaternary deposits are widespread but discontinuous, and contain fluviatile, playa lake and aeolian sediments.

PREVIOUS INVESTIGATIONS

Geological

Geological mapping by SADME geologists has been completed for the MARREE 1:250 000 scale map sheet (Forbes et al., 1965) and is currently in progress for the adjoining CURDIMURKA 1:250 000 scale map sheet. A preliminary edition of this sheet has been compiled by Daly (1970). Regional geological coverage is provided by the 1:1 000 000 State Geological Map (Thompson, 1980).

Groundwater Drilling

Previous drilling dates back to the late 1800's and early 1900's and has been mainly directed at the search and utilisation of artesian groundwater (Table 2). Records of this drilling are available from the SADME borefile records and, although the driller's lithological descriptions are often brief, the information can aid subsurface mapping if used in conjuction with later drilling information.

Waterbores drilled since 1980 are generally well documented and provide more detailed lithological descriptions and wireline geophysical logs. The Clayton-2 waterbore drilled in 1980 by SADME to a depth of 555 m was part of an assessment of the potential of the Great Artesian Basin for future water supply development (Smith and Read, 1982). In 1983 it was deepened to 568 m in order to determine the thickness of deeper aquifers and test the nature of pre-Mesozoic basement (Rogers 1984). In 1983, Muloorina-1 was completed by SADME as a waterbore for Muloorina homestead and was drilled into pre-Mesozoic basement (TD 618 m) to identify the nature of rocks forming the Muloorina Ridge (Forbes 1984).

Mineral Exploration

In 1980, CRA Exploration Pty. Ltd. were granted four exploration licences (No. 646 to 649) over an extensive area to the north of Marree (CRA Exploration Pty. Ltd., 1980). They considered the area had potential for oil shale because of lithological similarity of the Cretaceous sequence in this area to the Cretaceous sequence in Queensland which hosts the Julia Creek oil shale deposit.

During CRA's investigation, SADME drilled the Clayton-2 waterbore and tests of the drill cuttings from this borehole and from other existing waterbores, provided sufficient data for them to substantially downgrade the area's potential for economic oil shale deposits. The area was relinquished without any further exploration drilling being undertaken.

PREVIOUS COAL OCCURRENCES

Kuntha Hill

In South Australia the first discovery of coal in the Winton Formation was made in 1888 at Kuntha Hill near the Birdsville Track, about 160 km north-northeast of Marree (Figure 2). This occurrence is approximately 100 km north of the Clayton Area and represents coal seams from a higher stratigraphic level of the Winton Formation that is not present in the Clayton Area.

In the 'Record of Mines of South Australia' (Brown, 1890) the following information was provided by the manager of the private company formed to prospect the discovery:

- three shafts and two bores were put down vertically, the depth of the shafts being 21.3 m, 25.6 m, and 45.7 m; and of the bores, 90.8 m and 34.1 m.
- three seams of coal were intersected, with thickness of 0.76 m, 0.60 m and 0.13 m.

Two samples brought to Adelaide by the manager were submitted to the Government Assayer, for analysis with the following results:

	First Sample	Second Sample
Moisture (?air-dried)	11.68%	11.00%
Volatile Matter	36.63%	36.77%
Fixed Carbon	42.70%	43.39%
Ash	8.99%	7.84%

The Government Geologist (H.Y.L. Brown) visited the area in the early part of 1889 and inspected the shaft in which the coal had been discovered. The shaft was dewatered, but the manager found that is was unsafe to remove the timber at the place where the coal had been found and it was therefore not possible to ascertain the character or thickness of the seam. However, in the presence of the Government Geologist a hole was cut in the timber and a sample obtained but analytical records do not exist for this particular coal sample.

Waterbore Records

In the Clayton Area the Sinclair, Clayton and Dulkaninna waterbores were drilled during the late 1800's and early 1900's and the old drilling records show they intersected carbonaceous and lignitic intervals in the Winton Formation. These occurrences occur at depths that range from 20 m to 100 m, but the nature and thickness of the coal cannot be substantiated because only driller's cuttings description logs are available.

Coal intersections have been recorded in waterbores drilled by SADME at Clayton-2 in 1980 and at Muloorina-1 in 1983. The coal was recorded from drill cuttings and seam thicknesses of less than 1 m were confirmed from caliper-density wireline logs. In Clayton-2 the coal seams occur at depths of about 48 m and 83 m, and at a depth of 55 m in Muloorina-1.

The drill cuttings from the coal interval in Clayton-2 were sampled and analysed by CRA Exploration Pty. Ltd. (1980) and the analytical results are presented in Appendix II. The coal analyses are not totally representative of the coal intersected because the samples analysed were drill cuttings from rotary-mud drilling and are possibly contaminated by moisture and ash. Follow-up coal exploration was not undertaken by CRA because they considered the coal seams too thin and of low rank.

DRILLING INVESTIGATION

Drilling Programme

Four boreholes, ranging in depth from 36 m to 175 m were drilled in the Clayton Area between the 25 June 1985 and 13 July 1985. A total of 140 m of HQ coring and 373 m of open-hole drilling using rotary-mud drilling techniques were completed. The drilling was conducted by the SADME, Engineering and Services Division using a MAYHEW 1000 rig equipped for HQ wireline coring.

The boreholes were geophysically logged using the SADME "FORD" unit which produced analog readouts but had no provision for digital recording of data. Drilling and geophysical logging statistics are presented in Table 1 and the borehole locations are shown in Figure 5.

Clayton-3 was cored to a depth of 150 m through the Quaternary and Tertiary cover, and into the basal part of the Winton Formation and underlying Mackunda and Oodnadatta Formations. It was sited approximately 700 m east of the Clayton-2 waterbore in which several thin coal intersections had been previously recorded in the Winton Formation. An unanticipated anticlinal structure and a thick Tertiary cover at the Clayton-3 site resulted in the drilling of a reduced thickness of Winton Formation (Figure 6).

The core descriptions and geophysical logs for Clayton-3 are presented as a composite log in Figure 4.

Three open-holes CA1, CA2 and CA3 were positioned at distances of between 10 km and 20 km from Clayton-3 to determine the distribution of Winton Formation and test for coal occurrence. Lithological descriptions for these boreholes are presented in Appendix I and were based on cuttings collected every 2 m.

At the CA1 site the Winton Formation was absent and the borehole was spudded into the Oodnadatta Formation. This result confirmed the existence of an anticlinal structure directly east of Clayton-3 (see Section A-A', Figure 6).

Boreholes CA2 and CA3 were drilled to the east and north of Clayton-3 respectively. At both sites the prospective Winton Formation is covered by about 40 m of Quaternary and Tertiary sediments.

Clayton-3 Stratigraphy

The Cretaceous sequence drilled in Clayton-3 has been subdivided into 3 main intervals based on lithological character and to a lesser extent on geophysical log response. These intervals have been tentatively correlated with the Winton, Mackunda and ? Oodnadatta Formations. A generalised description of the proposed lithostratigraphic subdivision in Clayton-3 is given below.

Quaternary/Recent Depth Interval 0 to 2 m

Brown to red-brown, unconsolidated, sandy/silty clay.

Eyre Formation (Tertiary) Depth Interval 2 to 32 m

Predominantly fine grained sand, poorly consolidated, clayey and silty in part, with coarser sand at the base. The basal sands provide a good SP, neutron and gamma-ray geophysical log signature. Minor lignitic clay and carbonaceous sand horizons occur near the base of the sequence. The basal contact with underlying Cretaceous sediments is sharp and erosional.

Winton Formation (Cretaceous) Depth Interval 32 to 61 m

Interbedded brown-grey mudstone, siltstone and minor light sandstone. The mudstone are brown-grey, variably carbonaceous, with carbonaceous grains, flecks and wood fragments dispersed on bedding surfaces. The siltstone and sandstone interbeds are light green-grey in colour and clayey. A thin (0.15 m) coally, carbonaceous mudstone horizon occurs at 51.5 m. Occasional thin (0.02-0.05 m) horizons or concretions of off white, very hard, dolomitic mudstone occur in the mudstone.

Mackunda Formation (Cretaceous) Depth Interval 61 to 118 m

The formation comprises two prominent sandstone units between 70-81 m and 100-118 m, and the remainder consists of interbedded mudstone and sandstone. The sandstone is fine to medium grained, light green-grey and often clayey. Small to medium scale cross-bedding is common and mudstone clasts and carbonaceous grains/flecks are often dispersed on bedding planes. A thin section examination of a typical sample indicates that it is an immature, argillaceous sandstone containing detrital quartz and feldspar grains as well as green clay pellets and detrital clinoptilolite. The green clay pellets which account for the greenish colour of the sediment were identified as smectite by X-ray diffraction (see AMDEL Rept. - Appendix III).

The mudstone is brown to light brown and contains thin laminae of very fine grained sandstone and thicker fine grained sandstone interbeds. The overall arenaceous nature of this formation is represented by an increased SP response, and a slightly enhanced neutron and gamma-ray geophysical log response.

?Oodnadatta Formation (Cretaceous) Depth Interval 118-150.4 m (T.D.)

Interbedded brown and green-brown mudstone, green-grey siltstone and green-grey sandstone. In part, the sequence displays prominent colour/lithological banding due to repetitive cycles of "fining-up" sequences grading from fine sandstones through to siltstone and mudstone beds. Occasional calcareous shell gragments and bioturbated horizons are present. Sandstones are very fine to fine grained, and are often finely cross-bedded. In this interval the predominance of mudstone and siltstone over sandstone produces a suppressed SP, neutron and gamma response.

A palynological study undertaken by Alley (1986) on core samples attempted to substantiate the proposed lithostratigraphic subdivision and in particular, to identify the Winton and Mackunda Formations. The study clearly identified the Tertiary from the underlying Cretaceous but could not recognise any significant differences in the palyno-floras in the Cretaceous. The palynological evidence indicated that the non-marine Winton Formation occured to at least a depth of 128 m. The age of sediments below 128 m has not been determined at this point in time, but will be investigated in a later study (N. Alley pers. comm.).

In this report the proposed lithostratigraphic subdivision of the Cretaceous sediments in Clayton-3 will be retained despite the unsupportive palynological results. This subdivsion has been based on both the lithological character and geophysical response of units and has proved particularly useful for subsurface mapping of the Cretaceous sequence in the Clayton Area. However, further study is warranted to resolve the discrepency in palynological and lithostratigraphic information.

Coal Occurrence

In the Winton Formation in Clayton-3, a thin (0.15 m), black, carbonaceous mudstone interval containing a 0.02 m thick coal stringer was intersected at a depth of 51.5 m (Figure 4). The interval was too thin to warrant analysis for coal quality evaluation. Other carbonaceous intervals intersected, consisted of grey to black carbonaceous mudstone with dispersed fine grained, black, carbonaceous matter and occasionally, coarse black detrital wood fragments up to 0.05 m in size.

Borehole CA2 was drilled approximately halfway between the Muloorina-1 and Clayton-2 waterbores and penetreated 40 m of the Winton Formation. No coal seams were encountered although several thin carbonaceous mudstone intervals were intersected.

In the Clayton area the thickest potential coal zone was intersected in borehole CA3 at a depth of 90 m and consists of 3.5 m of highly carbonaceous or coally mudstone with a thin coal bed a metre thick. A core was not cut for coal quality evaluation but a geophysical wireline log (caliper & density) interpretation of the interval is:

Depth (m)	Lithological Interpretation	Thickness (m)
90.5 - 91.0	highly carbonaceous/coally mudstone	0.50
91.0 - 92.0	carbonaceous mudstone	1.00
92.0 - 93.0	coal	1.00
93.0 - 94.0	highly carbonaceous/coally mudstone	1.00

The coal seams intersected in boreholes Clayton-2, Clayton-3, and CA3 are thin and discontinuous and cannot be confidently correlated between boreholes. Since suitable core data is not available, the quality and rank of the coal remains uncertain, although from the limited analytical data available from the Kuntha Hill and Clayton-2 occurrences, the rank appears to be Lignite A or Sub-bituminous C (ASTM).

Apart from the coal occurrences in the Winton Formation, carbonaceous sediments also occur in the underlying Mackunda Formation and overlying Tertiary. In the Mackunda Formation, rare laminae of black, fine grained carbonaceous matter with the occasional, coarse, detrital wood fragment occur in the mudstones and sandstones. In the Tertiary sequence, carbonaceous sediments occur in the basal part of the Eyre Formation as thin interbeds of carbonaceous sand and soft clay, and were intersected in boreholes Clayton-3, CA2 and CA3. Rarely do these carbonaceous sediments develop into significant coal (lignite) seams.

Geological Interpretation

Previous geological mapping in the Clayton Area did not differentiate the Winton and Mackunda Formations. On the MARREE 1:250 000 map sheet these formations are combined and mapped as Blanchwater Formation (Forbes 1966), while on the State 1 million geological sheet the Mackunda Formation has been included in the unit mapped as 'Winton Formation'.

To assess the prospectivity of the Winton Formation it was necessary to define the Winton-Mackunda Formation boundary and map the distribution of the Winton Formation. This was achieved by reinterpreting existing surface geological mapping and subsurface waterbore data in conjunction with the proposed lithostratigraphic subdivision for Clayton-3.

The top of the Winton Formation is well defined and is marked by the presence of coarse, basal sands of the overlying Eyre Formation. The base of the Winton Formation is generally gradational and has been placed above the first pronounced sand development in the Mackunda Formation.

The interpreted formation depths and thicknesses from this programme are presented in Table 2 and tentative correlations between Clayton-3 and other boreholes drilled in the Clayton Area are shown on geological cross-sections in Figure 6.

The interpreted sub-crop boundary between the Winton and Mackunda Formation, and a revised structural interpretation for the eastern portion of the Clayton Area are shown in Figure 5.

In the Clayton Area, the thickness, depth and distribution of the Winton Formation is controlled by Tertiary sedimentation and regional structure. Due to Tertiary erosion, the Winton Formation thins markedly along the western limb of the Cooryanna Dome and is entirely absent from the central protion of the dome. Evidence of this angular discordance can be seen in the Hayes Hill area on geological section A-A' (Figure 6). Tertiary and Quaternary sediments occupy a structural depression west of the Cooryanna Dome and the prospective Winton Formation in this area is covered by up to 110 m of these sediments.

CONCLUSIONS

The Clayton area contains the southern-most occurrence of Late Cretaceous Winton Formation in South Australia and the Formation's potential for coal deposits was investigated by reconnaissance drilling.

Four boreholes were completed without discovering any significant coal seams.

The Clayton-3 borehole was cored through the Tertiary and Cretaceous to provide stratigraphic information, while three additional open boreholes were drilled to test the extent and nature of coal seams intersected in Clayton-2 and 3.

The best intersection of coal was made at a depth of 92 metres in borehole CA3 which consisted of a thin bed of coal about one metre thick. The structure and distribution of Winton Formation in the Clayton Area indicates that shallower coal may

occur between the Birdsville Track and Winton Formation subcrop to the east of borehole CA3, but it is highly unlikely that substantially thicker coal would develop. To the west of borehole CA3 and Clayton-3, the potential for economic coal seams is further reduced by the presence of thick Tertiary cover of the Lake Eyre Basin and the absence of coal in borehole CA2.

Cores for coal quality evaluation were not cut, therefore the quality and rank of the coal remains uncertain, but based on the limited analytical data available from the Kuntha Hill occurrence and drill cuttings from the Clayton-2 waterbore, the coal rank is Lignite A or Sub-bituminous C (ASTM Classification).

The coal intersections made to date in the Winton Formation in the Clayton area are too thin and discontinuous to warrant follow-up exploration.

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TABLE 1 CLAYTON AREA DRILLING PROGRAMME:- DRILLING AND GEOPHYSICAL LOGGING DATA

DRILLING

HOLE NO	SADME UNIT NO	COORDINATES (approx) Long.	Lat.	ELEVATION (approx) m	DATE DRILLED	DEPTH DRILLED m	ROTARY OPEN m	CORED (HQ) m
CLAYTON-3	6539-10	138°22'55"	29°16'30"	43	1.7.85	150	10	140
CA-1	6539-11	138°28'10"	29°15'25"	44	2.7.85	36	36	-
CA-2	6539-12	138°05'25"	29°15'55"	29	8.7.85	175	175	-
CA-3	6539-13	138°24'10"	29°11'10"	44	12.7.85	152	152	-
					TOTAL	513	373	140

CONTRACTOR: SADME

RIG: Mayhew R D8

Note: Borehole co-ordinates and elevations have been estimated off 1:250,000 scale topographic maps.

GEOPHYSICAL LOGGING

HOLE NO	DATE LOGGED	SADME FILE NO	DEPTH LOGGED	GEOPYSICAL LOGS GAMMA	NEU.	SP	RES.	CAL.	DEN.	16"Norm.	64"Norm.
CLAYTON-3	10.7.85	6539-10	150.2	X	X	X	X	X	X	X	X
CA-1	4.7.85	6539-11	34.8	X	X	-	-	X	X	-	-
CA-2	9.7.85	6539-12	168.4	X	X	X	X	X	X	X	X
CA-3	12.7.85	6539-13	152.9	X	X	X	X	X	X	-	-

CONTRACTOR: SADME

UNIT: 'Ford'

TABLE 2 CLAYTON AREA: SUMMARY OF BOREHOLE AND STRATIGRAPHIC INFORMATION

BOREHOLE	YEAR DRILLED	DEPTH metres	EL Estimated	DRILLING OBJECTIVE	BOREHOLE DATA			INTERPRETED BOREHOLE STRATIGRAPHY					
					Cuttings	Core	Geophysical logs	QUAT/TERTIARY Depth to Base	QUAT/TERTIARY Thickness	WINTON FM Depth to Base	WINTON FM Thickness	MACKUNDA FM Depth to Base	MACKUNDA FM Thickness
LAKE HARRY BORE	Late 1800's to early 1900's	408		waterbore	X	-	-	4	4	-	0	60	56
CLAYTON BORE		511	43	"	X	-	-	24	24	70	46	180	110
SINCLAIR BORE		511	70	"	X	-	-	18	18	90	72	180	90
TARKANINA BORE		373	55	"	X	-	-	0	0	0	0	36	36
DULKANINNA BORE		668	130	"	X	-	-	22	22	90	68	182	92
PEACHAWARINNA BORE		746	63	"	X	-	-	110	110	254	140	390	136
COORYANINNA BORE		487	40	"	X	-	-	5	5	-	0	60	55
JEWELLERY BORE		528	25	"	X	-	-	10	10	-	0	80	70
YARRA HILL BORE		313	70	"	X	-	-	4	4	-	0	-	0
CHAPPALANNA BORE		417	60	"	X	-	-	4	4	-	0	88	84
NICKOTIME BORE		427	70	"	X	-	-	4	4	-	0	60	86
LAKE LETTY NO 3		490		"	X	-	-	10	10	40	30	140	100
CROWS NEST BORE		382		"	X	-	-	2	2	-	0	-	0
CLAYTON-2	1980	568	42	"	X	-	X	32	32	105	73	190	85
MULOORINA-1	1983	618	30	"	X	-	X	24	24	112	88	198	86
CLAYTON-3	1985	150	43	geological	X	X	X	32	32	61	29	150	89
CA-1	1985	36	44	"	X	-	X	-	0	-	0	-	0
CA-2	1985	175	29	"	X	-	X	46	46	84	38	162	78
CA-3	1985	152	44	"	X	-	X	39	39	104	65	152	48

APPENDIX I

BOREHOLE GEOLOGICAL LOGS

BOREHOLE GEOLOGICAL LOG

BOREHOLE: CA1 (SADME Unit No. 6539 -11)

PROJECT: CLAYTON DRILLING PROGRAMME (Coal Investigation)

Location: approx. Lat. 29° 15' 25" Elevation: approx. 44m
Long. 138° 28' 10"

Total Depth: 36m Drilling Rig: SADME Mayhew RD8

Date Drilled: 2.7.85. Method: open hole, rotary-mud

Logged by: G. Kwitko Sampling: cuttings, 2m intervals

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	6	CLAY (Weathered Mudstone) - karki with minor orange-brown staining, soft and clayey, scattered gypsum fragments.
6	36 TD	MUDSTONE - grey, mod. indurated, calcareous white shell fragments between 10 - 12m, 16 - 18m, 20 - 22m, 24 - 26m, 28 - 30m and 32 - 34m.

Interpreted Stratigraphy

0	36m	Cretaceous: Oodnadatta Formation

BOREHOLE GEOLOGICAL LOG

BOREHOLE: CA2 (SADME Unit No. 6539 - 12)

PROJECT: CLAYTON DRILLING PROGRAMME (Coal Investigation)

Location: approx. Lat. 29° 15' 55" Elevation: approx. 29m
Long. 138° 05' 25"

Total Depth: 170m Drilling rig: SADME, Mayhew RD8

Date Drilled: 10.7.85 Method: open hole, rotary-mud

Logged by: G. Kwitko Sampling: cuttings, 2m intervals

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
0	1	GRAVEL /SAND/CLAY - red brown alluvium. (Weathered Clay/Claystone below).
1	4	CLAY - light brown to off white, silty clay, abundant gypsum.
4	7	CLAY/CLAYSTONE - offwhite, karki to olive green, soft with minor moderately indurated claystone horizons, trace dispersed silt and vfg sand.
7	8	SILCRETE - off white, very hard silicified white claystone, (tricone roller bit required). Fractures and vughs resulted in loss of mud circulation.
8	14	CLAYSTONE - light green, off-white, alternating soft and very hard silicified (silcreted) claystone horizons.
14	16	CLAY - yellow, light brown, soft and sticky, minor dispersed silt and sand grains. (weathered equivalent of unit below).
16	18	CLAY - karki to olive green, soft, dispersed silt and sand grains.
18	22	SILTY SAND - vfg, off white to light brown (poor cuttings return).
22	24	SAND - vcg, loose sand, light yellow to offwhite, numerous yellow oxidised quartz grains.
24	36	SAND - fg - mg, off white to light yellow, loose sand, clay cement, minor offwhite to purple clay interbeds and oxidised (yellow-orange) moderately indurated silty fg sandstone horizons. (Base of oxidation = 36m)

From	To	
36	38	SAND - cg and vcg, off white to grey, minor quartz granules/pebbles up to 10mm (opaque and clear), thin interbeds of grey and black carbonaceous clay.
38	40	SAND - cg (as above).
40	46	SAND AND CLAY - mg and cg clayey sand with clay interbeds. Clays are soft and sticky, predominently grey, minor black, highly carbonaceous clay interbeds and thin lignite stringers or scattered lignitic wood fragments.
46	64	MUDSTONE - grey, minor dark grey. Dispersed fine to coarse carbonaceous grains and flecks and coalified wood fragments. Thin (less than 0.05m) interbeds of dolomitic mudstone - off white, mod. to well indurated.
64	80	MUDSTONE - grey minor brown-grey, mod. indurated (as above). Minor light grey/ green-grey siltstone laminae (discontinuous, lenticular in nature).
80	84	MUDSTONE - brown-grey, soft with dispersed carbonaceous grains/flecks and a few scattered black coalified wood fragments.
84	106	MUDSTONE AND SANDSTONE - Predominantly mudstone with thin interbeds of vfg and fg silty or clayey sandstone. Mudstone - grey-dark green-grey with dispersed fine carbonaceous grains/flecks. Sandstone - light green-grey, silt/clay cement, trace carbonaceous grains/flecks on bedding planes.
106	150	SANDSTONE AND MUDSTONE - As above - but poor cuttings return indicates predominance of silty and clayey vfg/fg sandstone. Very well indurated off white dolomitic mudstone horizons (0.05 - 0.10m) at about 111m and 126m.
150	170 TD	MUDSTONE - dark green-grey, minor thin interbeds of siltstone and silty/clayey vfg sandstone

Interpreted Stratigraphy

0	1	Quaternary
1	18	Tertiary - Etadunna Formation
18	46	Tertiary - Eyre Formation
46	170	Cretaceous - Winton, Mackunda and Oodnadatta Formations.

BOREHOLE GEOLOGICAL LOG

BOREHOLE: CA3 (SADME Unit No. - 6539-13)

PROJECT: CLAYTON DRILLING PROGRAMME (Coal Investigation).

Location: approx. Lat. 29° 11' 10" Elevation: approx 44m

Long. 138° 24' 10"

Total Depth: 151m Drilling Rig: SADME, Mayhew RD8

Date Drilled: 12.7.85 Method: open hole, rotary-mud

Logged by: G. Kwitko Sampling: cutting, 2m interval

DEPTH (metres) From	To	CUTTINGS DESCRIPTION
1	2	SAND/SILT/CLAY - orange/brown, unconsolidated.
2	6	SAND/SILT/GRAVEL - light brown to cream unconsolidated, gypsiferous, minor calcareous/calcrete horizons.
6	10	CLAY - maroon, karki, red-brown, soft and sticky, scattered hard red-orange ferruginised siltstone fragments, trace gypsum (highly weathered equivalent of unit below)
10	20	CLAYSTONE - light green and grey-brown, moderately indurated, red and purple ferruginous staining on fracture and bedding surfaces, rare gypsum.
20	24	CLAY - yellow, karki, soft and sticky.
24	16	CLAY - maroon (as above).
26	28	CLAY - dark grey and black, highly carbonaceous in part, soft and sticky nature.
28	30	CLAY - multicoloured grey, off white, yellow, maroon.
30	34	SAND - mg to vcg, off white, minor white quartz granules (up to 10mm), poorly sorted, minor soft white clay matrix in part. Minor orange (ferruginised/oxidised) fg sand and siltstone horizons.
34	39	SAND AND CLAY - sand as above, but grey and not oxidised, with more abundant soft, white and grey clay interbeds. Grey to dark grey, and black highly carbonaceous clay interbeds near base.
39	52	MUDSTONE - light grey, minor light grey-brown,

From	To		
			soft and poorly indurated, minor dark grey/ black carbonaceous interbeds. Dispersed fine carbonaceous fragments and grains.
52	62		MUDSTONE - grey, moderately indurated, dispersed fine, carbonaceous grains and flecks. Thin, hard, off white, dolomitic mudstone horizons at about 56m, 60m and 62m.
62	76		MUDSTONE AND SANDSTONE - grey, brown-grey, mudstone as above, with interbeds of light green-grey clayey?, silty, vfg sandstone. Dispersed fine carbonaceous matter.
76	104		MUDSTONE - grey, grey-brown, minor interbeds and laminae of light grey siltstone or silty/clayey vfg sandstone. Dispersed fine carbonaceous grains/flecks and rare black coalified wood fragments. Thin (less than 0.10), hard, off white to grey, dolomitic mudstone horizons at about 86m, 95m and 104m. A highly carbonaceous mudstone with a thin high ash coal seam (less than 1m) occurs between 90m and 94m.
104	152	TD	MUDSTONE, SANDSTONE and SILTSTONE - interbedded, grey, brown-grey mudstone with interbeds of light grey and light green-grey, vfg and fg, silty and clayey? sandstone and siltstone.

Interpreted Stratigraphy

0	6	Quaternary
6	20	Tertiary - Etadunna Formation
20	39	Tertiary - Eyre Formation
30	152	Cretaceous - Winton and Mackunda Formations

APPENDIX II

CLAYTON-2 COAL ANALYSIS

CLAYTON-2 - COAL ANALYSIS

Special Note: The samples analysed are drill cuttings collected by CRA Exploration Pty. Ltd. in 1980 from coal intervals, drilled in the SADME Clayton-2 water bore.

The analytical results may not be totally representative of the coal seams because of the drilling method (rotary-mud circulation) and sampling procedure used.

Drill Cuttings Sample No.	Driller's Depth, Interval
A	49 - 50 m
B	50 - 51 m
C	84 - 85 m
D	84.5 m

Proximate Coal Analysis (Results in Percentages)

Samples as Received:	A	B	C	D
Moisture	49.13	51.59	62.75	53.78
Volatile Matter	16.06	17.56	13.02	13.46
Fixed Carbon	18.98	19.97	17.60	16.28
Ash	15.83	10.88	6.64	16.48
	100.00	100.00	100.00	100.00
Moisture Free:				
Volatile Matter	31.57	36.28	34.95	29.12
Fixed Carbon	37.32	41.25	47.24	35.22
Ash	31.11	22.47	17.81	35.65
	100.00	100.00	100.00	100.00
Specific Energy (MJ/Kg, dry coal basis)	18640	21240	22460	17100
Total Sulphur (%, dry coal basis)	1.31	0.79	0.76	0.65
Sodium (%, dry coal basis)	0.28	0.28	0.44	0.28

APPENDIX III

AMDEL PETROLOGICAL REPORT G 6429/86

Sample Identification

AMDEL No	CLAYTON-3 BOREHOLE DEPTH (metres)
A 2690/85	54.0
A 2691/85	58.5
A 2692/85	76.2

The Australian Mineral Development Laboratories

Flemington Street, Frewville,
South Australia 5063
Phone-Adelaide (08) 79 1662
Telex AA82520

Please address all correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

5 September 1985

GS 1/2/0

South Australian Department of
Mines & Energy,
P.O. Box 151,
EASTWOOD, S.A. 5063

ATT: MR. G. KWITKO

REPORT G 6429/86

YOUR REFERENCE:	11/06/0621 EX-406
IDENTIFICATION:	A2690/85 to A2692/85
MATERIAL:	Split drill core
LOCALITY:	Clayton-3 borehole at depths of 54, 58.5 and 76.2 m
DATE RECEIVED:	16 August 1985
WORK REQUIRED:	Petrography (3 MA1.3) and X-ray diffraction (2 MB5)

Investigation and Report by: Frank Radke

Chief - Geological Services Section: Dr Keith J Henley

Keith Henley

for Dr William G Spencer
Manager,
Mineral & Materials Sciences Division

bp

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PETROLOGY OF THREE SEDIMENTARY ROCKS

1. INTRODUCTION

Three samples were submitted by the South Australian Department of Mines and Energy for petrographic examination. It was also requested that the green mineral in two of the samples be identified and after discussion with the Mines Department it was decided to examine these samples by X-ray diffraction as well as petrographically.

2. X-RAY DIFFRACTION

A portion of samples A2690/85 and A2692/85 were finely powdered and examined by X-ray diffraction to determine their bulk mineralogy and whether any glauconite is present. The results are given below listing the minerals in estimated decreasing abundance using the defined semi-quantitative abbreviations.

Sample A2690/85		Sample A2692/85	
Quartz	D	Quartz	D
Smectite	SD	Smectite	SD
Plagioclase	SD	Clinoptilolite	SD
Clinoptilolite	A	Plagioclase	A
Kaolinite	A	Kaolinite	Tr-A
Mica	Tr	Amphibole	Tr
		Mica	Tr

SEMIQUANTITATIVE ABBREVIATIONS:

D = Dominant. Used for the component apparently most abundant, regarless of its probable percentage level.

CD = Co-dominant. Used for two (or more) predominating components, both or all of which are judged to be present in roughly equal amounts.

SD = Sub-dominant. The next most abundant component(s) providing its percentage level is judged about about 20.

A = Accessory. Components judged to be present between the levels of roughly 5 and 20%.

Tr = Trace. Components judged to be below about 5%.

In neither sample was a glauconite mineral detected and is believed that the green mineral is smectite. In thin section green clay pellets which at least petrographically would be called glauconite are present but from the X-ray diffraction results the only possible mineral it could be is smectite.

3. PETROGRAPHY

All the thin sections of samples A2691 and 92 were stained with an alizarin red-S solution to distinguish calcite from other carbonates by staining it pink. Sample A2692 contains a weakly birefringent, fibrous mineral which is weakly stained by the solution and from the X-ray diffraction results is considered to be clinoptilolite.

SAMPLE: A2690: TSC45663

Rock Name:
Argillaceous Sandstone

Hand Specimen:
This is a lamellar banded rock with a grey to greenish-grey colour and a very fine grained, friable texture.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	35
Clay pellets	30
Feldspar	15
Clay/sericite	10
Clinoptilolite	5
Carbonate	3
Opaques	2

This is a detrital sedimentary rock comprised mainly of angular to subangular detrital quartz and feldspar grains and green clay pellets. The detrital quartz and feldspar grains are between 0.1 and 0.15 mm in size. The detrital feldspar consists largely of polysynthetically-twinned plagioclase although minor untwinned potash feldspar could also be present.

The green clay pellets are typically between 0.15 and 0.2 mm in size and have rounded shapes and very low birefringence. Petrographically these pellets would be called glauconite but the X-ray diffraction results shows no evidence of celedonite or a significant illite-like mineral which are the two varieties of glauconite. From the X-ray diffraction results they are considered to be pellets of green smectite.

Interstitial regions between the detrital mineral grains and clay pellets consists mainly of void spaces although some sericitic to weakly birefringent clay is locally present. Minor amounts of a weakly birefringent mineral considered to be clinoptilolite are also present in the matrix. The rock contains a band approximately 1 mm wide with a concentration of very finely granular, micritic carbonate. This band also contains some discontinous undulose lamellae of opaque to translucent iron oxides. Minor opaques are also disseminated through the rock as small grains up to 0.2 mm wide.

This is an immature detrital sediment comprised mainly of detrital quartz and feldspar grains and green clay pellets comprised of a smectite.

SAMPLE: A2691/85: TSC45664

Rock Name:
Dolomite

Hand Specimen:
This is a pale tan coloured rock with an irregular bedding on a scale of approximately 1 to several millimeters produced by slight variations and colour within different bands.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Carbonate	80
Quartz	10
(?)Clinoptilolite	3
Feldspar	2
Clay	2
Opaques and semi-opaques	3

This sample consists mainly of very fine grained carbonate which locally forms turbid, micritic textured clasts up to 0.3 mm wide which are distributed through a finely granular carbonate matrix. The banding which was noted in hand specimen is produced by bands up to approximately 3 mm wide which have a higher detrital component comprised mainly of fine sand-sized particles. Within these bands an interstital carbonate matrix is also present. The carbonate-rich bands have a weakly fragmental texture produced by the small carbonate clasts but consist largely of finely granular matrix carbonate.

The main detrital component in this rock is quartz which forms angular to subangular grains up to 0.1 mm wide. Minor feldspar and a very small number of clay pellets were also noted. These detrital particles are concentrated along bands although minor amounts of quartz-rich detritus are also disseminated through the carbonate-rich bands.

Within some carbonate-rich bands a weakly birefringent mineral which is stained by the alizarin red-S solution is intergrown with the carbonate as small patches up to 0.15 mm wide. This mineral is tentatively identified as clinoptilolite. Opaque to translucent iron oxides also form fine intergrowths with the carbonate and tend to be concentrated in discontinous elongate stringers oriented parallel to the banding.

This is a carbonate-rich detrital sediment comprised of an unstained carbonate which is most likely dolomite.

SAMPLE: A2692/85: TSC45665

Rock Name:
Argillaceous Sandstone

Hand Specimen:
This is a greenish-grey coloured rock with a finely granular, friable texture.

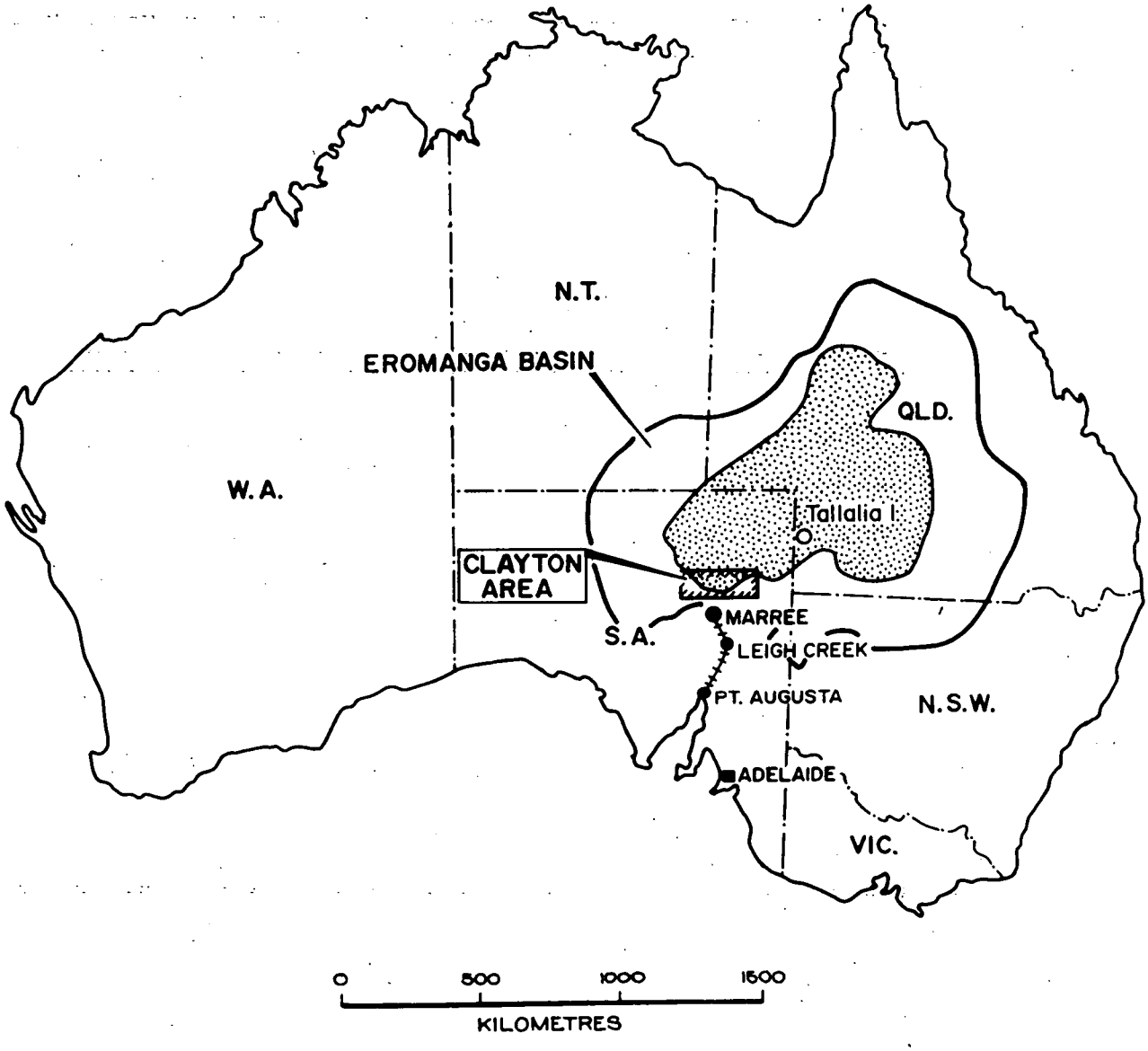
Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	40
Clay pellets	20
Clinoptilolite	20
Feldspar	10
Clay/sericite	8
Hornblende	1
Epidote	Tr
Biotite	Tr
Opaques	1

This is a detrital rock comprised mainly of detrital quartz and feldspar grains as well as detrital clay pellets and some detrital clinoptilolite pellets. The detrital quartz and feldspar grains are between 0.1 and 0.2 mm in size and exhibit angular and sub-angular shapes. The clay pellets have pale green to reddish-brown oxidised characters and petrographically could be called glauconite although the X-ray diffraction results indicate that they consist of a green smectite. The clinoptilolite pellets are up to 0.2 mm in size and consist of a weakly birefringent, fibrous textured material which is weakly stained by the alizarin red-S solution. The detrital feldspar consists at least in part of polysynthetically-twinned plagioclase. Minor hornblende is disseminated through the rock as small detrital particles up to 0.2 mm long which have a pleochroic green to yellowish-green colour. Traces of epidote and biotite were also noted as small detrital grains and flakes.

The interstices between the detrital mineral grains consist mainly of irregular voids. Minor amounts of clinoptilolite are locally intergrown as an interstitial matrix and some detrital quartz grains are rimmed by narrow clinoptilolite margins. Minor amounts of weakly birefringent clay and fibrous sericite also occur locally as interstitial fillings. Minor opaques are disseminated through the rock as small grains and aggregates up to 0.2 mm wide.

This is an immature detrital sediment containing detrital quartz grains as well as green smectite pellets and detrital clinoptilolite particles weakly cemented by clinoptilolite and argillaceous matrix.



Winton Formation distribution in the Eromanga Basin

Railway.

Tallalia-1 Petroleum Exploration Well.

Fig. 1

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED G. K.	C.D.O. 25·12·86 DATE
	DRAWN M. B.	SCALE As shown
CLAYTON AREA GENERAL LOCALITY PLAN	DATE May '86	PLAN NUMBER S18718
	CHECKED	

4089

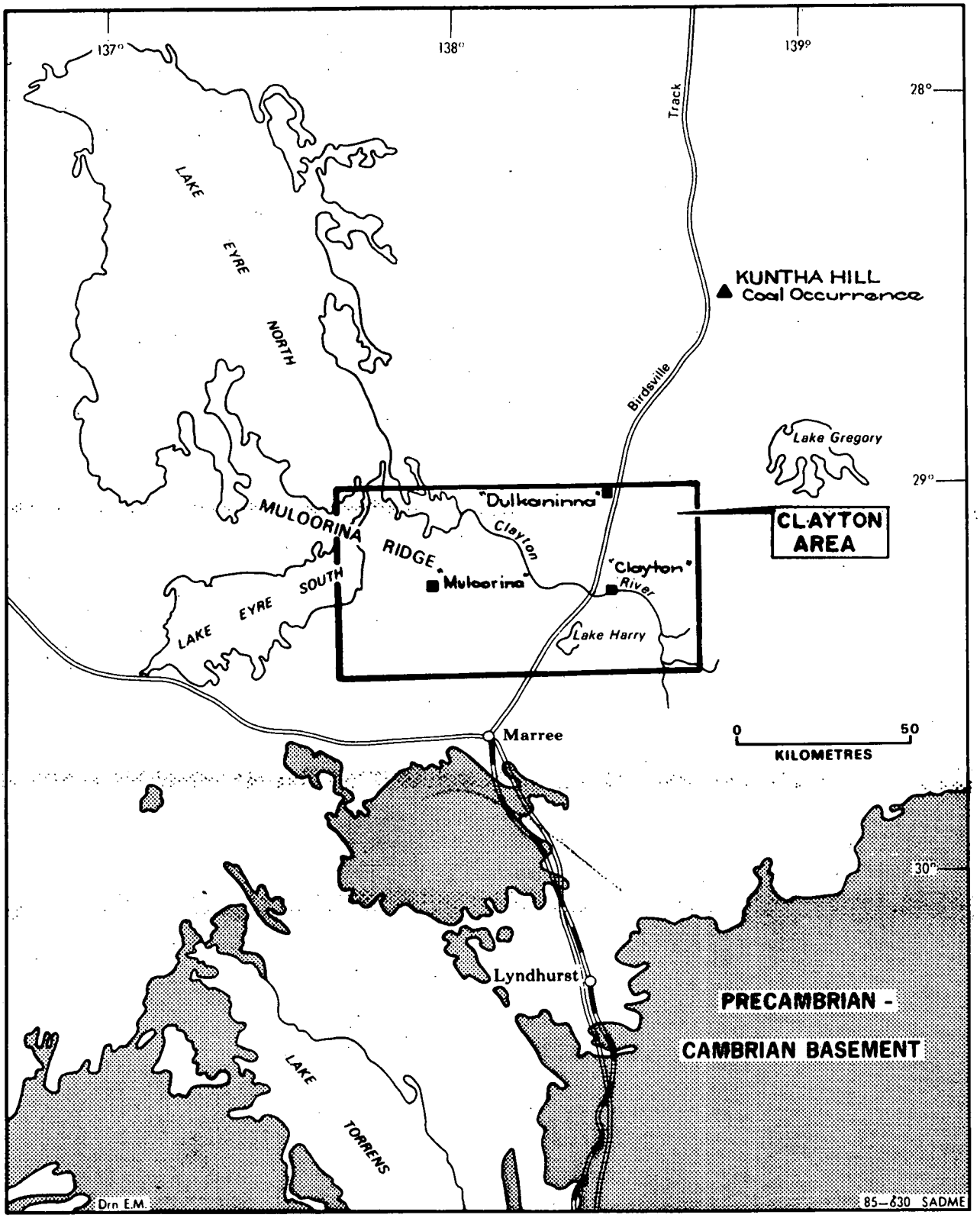
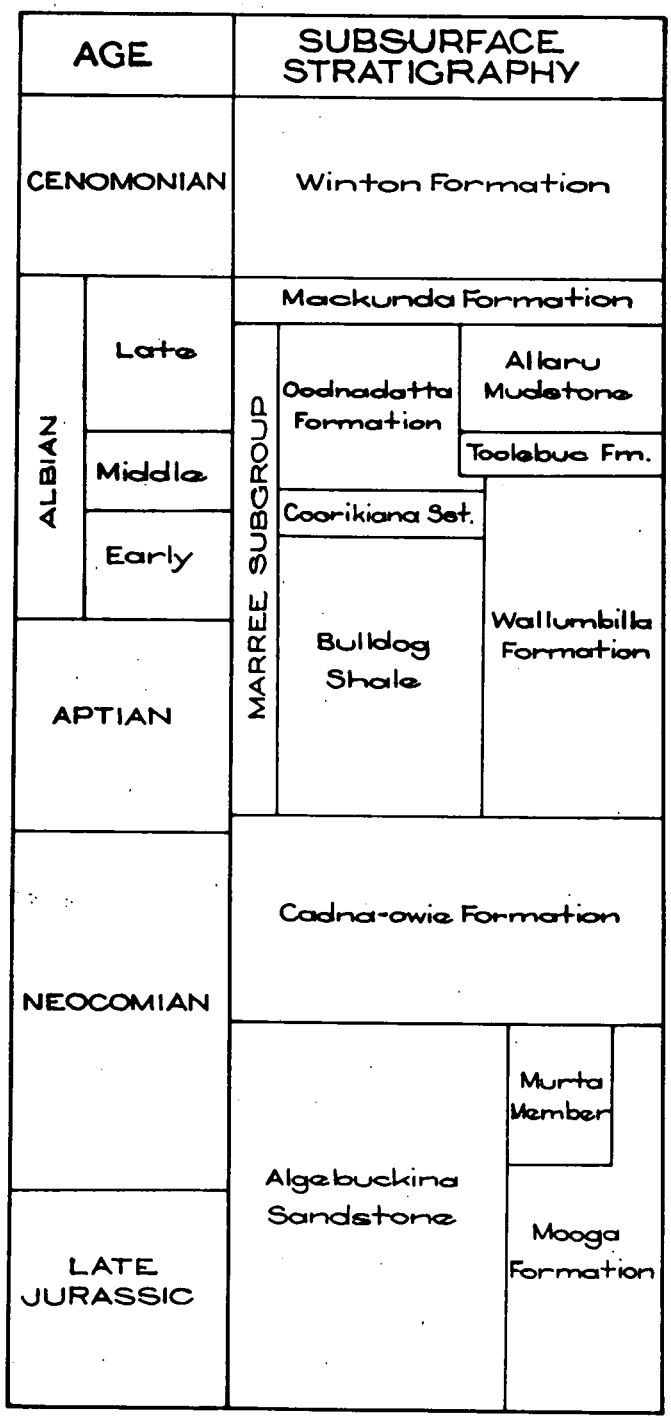


Fig. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED G.K.	C.D.O. 23·12·86 DATE
	DRAWN M.B.	SCALE As shown
CLAYTON AREA REGIONAL LOCALITY PLAN	DATE May '86	PLAN NUMBER S 18719
	CHECKED	

4089



(After Moore and Pitt, 1985)

Fig. 3

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED G. K.	C.D.O. 23·12·86 DATE
EROMANGA BASIN	DRAWN M.B.	SCALE
CRETACEOUS STRATIGRAPHY	DATE May '86	PLAN NUMBER S18720
	CHECKED	

CLAYTON 3 - COMPOSITE LOG

PROJECT : Clayton Area Drilling Programme

LOCATION : Approx. 50m north of old Clayton Bore and 700m east of Clayton-2.
Estimated Coordinates : Lat. 29° 16' 30"
Long. 138° 22' 55"
Estimated Elevation : 43m

UNIT / STATE No. : 6539-10

DRILLING : Contractor : SADME
Rig : Mayhew (RD 8)
Date drilled : 1-7-85
Cored interval : 6 to 11, 15·5 to 150·4m
Core size : HQ. (wireline)
Casing : 15m of 152mm PVC

GEOPHYSICAL LOGGING : Contractor : SADME
Unit : Ford
Date logged : 10-7-85
SADME Log Reference No's. : 3773, 3774, 3775

CORE LOGGING SYMBOLS

LITHOLOGY

- Sandstone - very coarse (vcg)
- Sandstone - coarse (cg)
- Sandstone - medium (mg)
- Sandstone - fine (fg) and very fine (vfg)
- Siltstone
- Mudstone (silty claystone)
- Gypsum
- py Pyrite (grains / nodules)
- # Calcareous
- Mudstone / claystone clasts (0·01 - 0·03)
- Black, coalified wood fragments (0·01 - 0·03)
- c Carbonaceous (dark grey to black)
- Calcareous shell fragments (macro fossils)
- Hard to very hard, off white on light brown dolomitic mudstone concretion / horizon (0·01 - 0·05)
- Core loss

SEDIMENTARY FEATURES AND STRUCTURES

CONTACTS

- Gradational
- Sharp and planar
- Erosional

BEDDING

- Even, continuous
- Wavy, discontinuous
- Small cross bedding
- Medium cross bedding

WIRELINE GEOPHYSICAL LOGS
SELF POTENTIAL
POINT RESISTIVITY
GAMMA
NEUTRON
DENSITY
5mV
10 API
10 cps
50 cps
WASH OUT
DEPTH m
STRATIGRAPHY
GRAINSIZE SCALE
SAND
vcg cg mg fg vfg
SILT
CLAY
CORE LITHOLOGY LOG
LITHOLOGICAL DESCRIPTION
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
QUATERNARY
TERTIARY - EYRE FORMATION
CRETACEOUS - WINTON FORMATION
CRETACEOUS - MACKUNDA FORMATION
?
CRETACEOUS - MACKUNDA / ?OODNADATTA FORMATION
SAND, SILT, CLAY brown to red brown, unconsolidated.
CLAYEY SILT / SILTY SANDSTONE vfg. Light brown, off white, cream; dispersed fg and mg qtz. grains.
START CORE
0·10 Silicified gravel horizon very hard light brown/yellow brown gravel fragments up to 4cm (quartzite chert & re worked sst from below) Matrix of v.f.g silty, clayey sand
SANDSTONE v.f.g. mod. hard, well cemented, yellow orange.
SAND c.g. minor gravel, loose unconsolidated off white to yellow, silt/clay matrix.
END CORE Rotary mud drilling to 15·5 m.
SAND very clayey/silty, vfg, soft and poorly consolidated, light brown / purple / off-white.
RESUME CORING
0·15 SANDSTONE mod. to very hard ferruginised dark red-maroon, fg, poorly sorted.
SAND vfg, fg, silty and clayey, off-white/maroon/light brown/light yellow brown, poorly consolidated, clay cement in part (oxidised)
SAND fg (minor mg interbeds, off-white, light brown Minor thin clay interbeds. Soft, poorly consolidated clay cement in part (oxidised).
Oxidised - reduced sand contact (Uranium Anomaly 5XGB).
SAND grey-brown, fg silty/clayey in part, slightly carb. well bedded (thin beds/laminae).
0·05 highly carb. lignitic clayey sand.
SAND grey-brown, mg & cg, minor vcg. at base, soft and poorly cemented in part, sub rounded to rounded grains mod. sorting, trace white clay cement, minor carb. grains.
Sharp erosional contact.
MUDSTONE 60% SILTSTONE 40% interbedded, bedding wavy, irregular & discontinuous, bed thickness 0·05-0·20. Mudstone is grey to light grey, soft. Siltstone is very clayey, off-white/khaki/light grey, with lenses & clasts of mudstone and dispersed carb. fragments and grains.
MUDSTONE dark brown-grey, soft.
MUDSTONE/SILTSTONE, interbedded, wavey, parallel bedding. Bed thickness 0·01 - 0·05. Mudstone is brown-grey. Siltstone is light grey becoming light green grey at base.
SANDSTONE vfg very clayey and silty, abundant mudstone lenses & thin interbeds. Very light green-grey, black carb. laminae, small scale (ripple) X-bedding in part. Graduational top & bottom contacts.
MUDSTONE dark brown-grey, irregular/poorly bedded. Scattered off-white mudstone clasts & lenses. Dispersed black carb. grains & flecks (Up to 10% in part).
Abundant, dispersed carb. grains/flecks (10-15%).
MUDSTONE as above but well bedded, laminated in part, with minor siltstone as off-white -light green-grey laminae and lenses.
0·15 dark grey-black carb. mudstone with 0·02 black coal bed at top.
SANDSTONE light green grey very clayey & silty v.f.g. irregular discontinuous disrupted bedding. Dispersed clay/mudstone clasts & carb fragments.
SANDSTONE fg & v.f.g. light green grey, trace silt/clay matrix & laminae. Carb. matter occurs as v.f.g. & fg. flakes // bedding. Small scale cross beds.
MUDSTONE dark brown-grey, dark grey to black carbonaceous, thinly bedded, well laminated in part. Minor thin laminae/lenses of siltstone or silty clayey vfg sandstone (light green-grey, light grey) Carb. grains & flecks dispersed and along bedding planes.
0·15 Sandstone fg. light green-grey.
Small scale slumping.
MUDSTONE 50% SANDSTONE 40% SILTSTONE 10% Interbedded, grey brown mudstone, light grey/green grey sandstone and siltstone. Thin beds, poorly bedded, lenticular nature. Sandstone vfg & fg poorly sorted, clayey & silty.
SANDSTONE light green-grey, mg silty & clayey abundant black coalified wood fragments (up to 0·05 m). Coalified wood fragments & carb matter up to 25% in part. Rare grey-brown mudstone clasts.
SANDSTONE light green-grey, fg minor mg & vfg, mod. indurated, trace clay cement. Minor, thin discontinuous carb. silt laminae and brown and light brown mudstone beds (<0·01 thick) & clasts. Carb grains & flecks on bedding planes.
SANDSTONE vfg to fg with silt/clay matrix and laminae.
Abundant thin interbeds of mudstone, brown, discontinuous / lenticular.
SANDSTONE 50% MUDSTONE 50% interbedded, bed thickens up to 0·05, irregular bedding, discontinuous & lenticular in part.
MUDSTONE brown/light brown, minor off white / light green grey, silty, vfg sst irregular and discontinuous laminae and beds.
MUDSTONE 70% SANDSTONE 30% (as above).
MUDSTONE 90% SANDSTONE 10% (as above).
Sandy/clayey beds with abundant detrital carb. matter and coalified wood fragments up to 0·5 m
Sharp erosive contact.
MUDSTONE 90% SANDSTONE 10% Sst. thin beds up to 0·01 as lenses/laminae vfg-fg.; silty, trace dispersal carb. grains.
MUDSTONE 60% SANDSTONE 40% sst. beds up to 0·05 thick.
SANDSTONE 60% MUDSTONE 40% sandier to base sst. beds up to 0·10 thick with mudstone clasts & interbeds. Carb. matter on X-beds, trace dispersed. Mudstone clasts & beds on X-beds. Small scale X-beds.
SANDSTONE mg. green-grey, brown mudstone clasts & laminae, carb. grains & flecks on X-beds.
Erosive contact.
MUDSTONE brown - light brown in part, bedded to finely laminated, mod. indurated. Interbedded silty vfg sandstone (off-white / light green grey) laminae & lenses (<1mm) Trace dispersed vfg. carb. grains & flecks in mudstone.
Sharp contact.
SANDSTONE light grey-green, grey, mod to well indurated, fg & vfg, trace silt/clay cement. Small scale X-bedding. Scattered mudstone clasts/pellets parallel to bedding, dispersed carb. grains/flecks & laminae.
Green-brown mudstone clasts (0·01)
Hard off-white/brown, calcareous clast.
Very hard calcareous mudstone concretion 0·02 thick, lenticular.
Scattered, weakly calcareous mudstone interbeds, lenticular & discontinuous (clasts / pellets).
Several thin (0·10) mudstone interbeds, weakly calcareous
py nodule
SANDSTONE mg. (as above) medium scale X-bedding
0·10 mudstone interbed.
0·01 thick horizons of detrital coalified wood fragments, carb silt laminae & mudstone clasts.
Erosive contact
MUDSTONE brown & green-brown, minor discontinuous / lenticular beds & laminae (<1mm) of green-greey silty vfg sst. and siltstone. Carb. grains & flecks on bedding planes.
Sst. interbeds fg, clayey with mudstone clasts & trace carb. grains / flecks.
MUDSTONE 60% SILTSTONE 30% SANDSTONE 10% Interbedded, bed thickens 0·05 to 0·15, banded appearance due to sedimentary cycles. Cycles grade from sst to siltstone and mudstone. Mudstone is brown, green-brown, siltstone & sandstone vfg is light green grey, clayey in part, small scale X-bed.
SANDSTONE fg & vfg. green-grey, thinly bedded / X-bedded, minor mudstone clasts.
MUDSTONE 60% SILTSTONE 30% SANDSTONE 10% (as above).
Bioturbated
MUDSTONE green-grey, patches of silt & vfg sst. Irregular, disrupted bedding (bioturbated).
MUDSTONE 80% SANDSTONE 20% (as above).
SANDSTONE : green-grey, fg, X-bedded.
MUDSTONE 80% SANDSTONE 20% (as above).
Top 0·05 bioturbated.
Date : 28-5-86
86-262
FIG. 4
TOTAL DEPTH 150·40 m.

FIG. 4

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

CLAYTON - MARREE AREA

CLAYTON-3, COMPOSITE LOG

COMPILED	G. K.
DRAWN	M. B.
DATE	May '86
CHECKED	[illegible] 23·12·86
PLAN NUMBER	86-262

4089

137°30'
29°00'
138°00'
138°30'
30°00'

CLAYTON LAKE

LAKE EYRE SOUTH

B — Peachawarinna Bore — T=110 W=254 — T=22 W=90 — Dulkaninna — Dulkaninna Bore — B'

A — Muloorina — Muloorina Bore — T=24 W=112 — T=46 W=84 — CA 2 — T=32 W=61 CLAYTON 3 — T=32 W=105 CLAYTON 2 — Clayton Bore — CLAYTON — CA 1 — T=39 W=104 CA 3 — T=8 W=90 Sinclair Bore — A'

Jewellery Bore — Cooryaninna Bore — COORYANNA DOME — Chapalanna Bore — Nickotime Bore — Yarra Hill Bore — Tarkanina Well

T=10 W=40 — Lake Letty No. 3

Crows Nest Bore

LAKE HARRY — Lake Harry Bore — Lake Harry

Attraction Hill

MARREE

0 5 10 15 20 25
KILOMETRES

Quaternary/ Tertiary cover.
Cretaceous outcrop.
Proterozoic outcrop.
} Outcrop boundaries from MARREE and CURDIMURKA (1:250,000) geological maps.

Syncline. Anticline.

Main road. Railway.

Strike and dip of bedding.

Water bore.

CLAYTON 3 ⊕ CA 1, CA 2, CA 3 — 1985 Exploration borehole.

T = 20 W = 150 — Interpreted Borehole Stratigraphy
T- Tertiary, depth to base (m)
W- Winton Formation, depth to base (m)

Interpreted Base of Winton Formation (subcrop).

A — Geological cross section (See fig. 6)

Fig.5

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

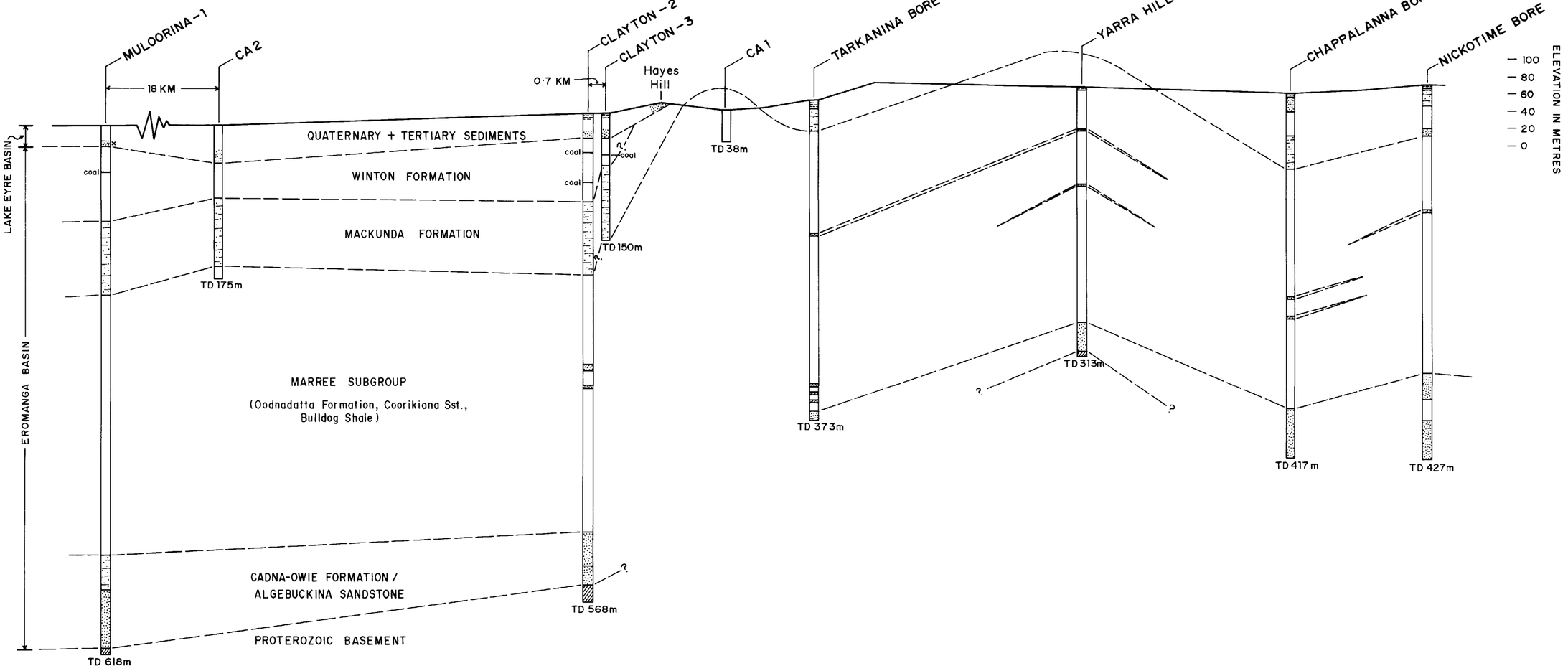
CLAYTON - MARREE AREA

BOREHOLE LOCATION AND GEOLOGICAL INTERPRETATION

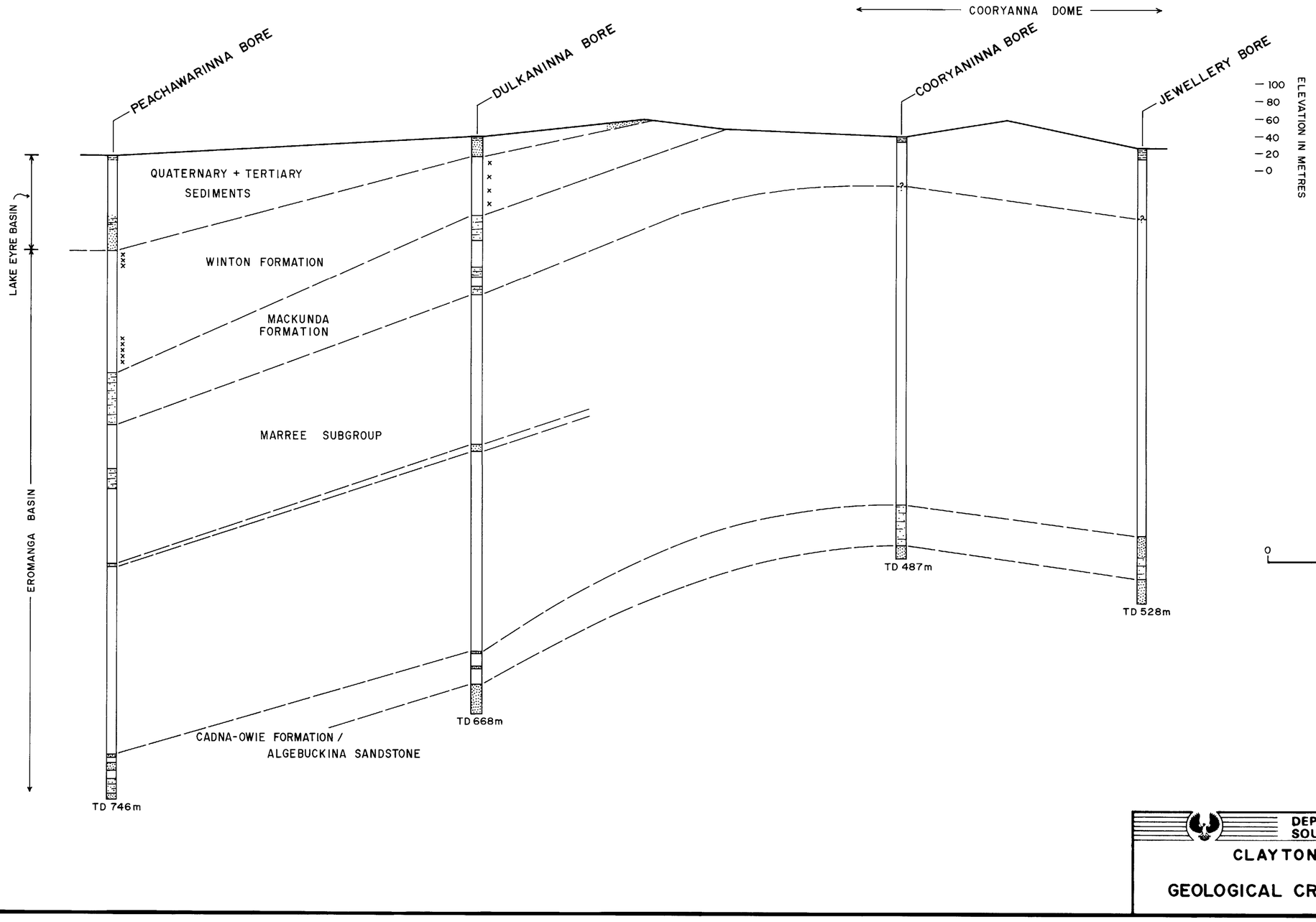
COMPILED	G. Kwitko
DRAWN	J.W.
DATE	May '86
CHECKED	
C.D.O.	23.12.86 DATE
SCALE	1:250 000
PLAN NUMBER	86 – 263

4089

A



B



LEGEND

- Alluvium – clay etc.
- Mudstone, claystone, shale
- Sandstone, sand
- Interbedded mudstone and sandstone
- Basement rock (Proterozoic)
- coal — Coal seams (up to 1m thick) interpreted from geophysical logs
- Carbonaceous/lignitic intervals reported in water bores
- Interpreted lithostratigraphic boundary

HORIZONTAL SCALE

0 5 10 15 20 25 KILOMETRES

Fig. 6

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

CLAYTON – MARREE AREA

GEOLOGICAL CROSS SECTIONS A-A', B-B'

COMPILED G.K.	CDO 23·12·86 DATE
DRAWN M.B.	SCALE 1 : 250 000
DATE May '86	PLAN NUMBER 86 – 264
CHECKED	

4089