DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK. NO. 84/43

DEEPENING OF CLAYTON NO. 2 WELL

GEOLOGICAL SURVEY

by

P.A. ROGERS

JUNE, 1984

DME.99/80

CONTENTS

PLAN

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 84/43
DME No. 99/80
Disk No. 70

DEEPENING OF CLAYTON NO. 2 WELL

ABSTRACT

Clayton No. 2 water well, situated near the south-west margin of the Eromanga Basin about 50 km northeast of Marree, was originally drilled to a depth of 555 m in 1980 and bottomed in a white to purple grey, slightly silty clay. It was not certain whether this material was a clayey zone of the Algebuckina Sandstone, Permian, or weathered basement.

In 1983, the hole was deepened to 568 m in order to determine the nature of the pre-Mesozoic basement. Cuttings of micaceous siltstone and fine-grained dolomitic quartz sandstone were obtained and petrographic examination revealed evidence of low-grade metamorphism, suggesting an Adelaidean age.

Geophysical logs were recorded over the bottom interval of the well, and these place the Mesozoic/Adelaidean contact at 548 m.

The results from Clayton-2, in conjunction with core obtained from Muloorina-1, 46 km to the west, indicate that the Muloorina Ridge gravity high is composed predominantly of Adelaidean sediments.

INTRODUCTION

In 1980, Clayton No. 2 well (Unit No. 6539-9) was drilled to a total depth of 555 m, at a position close to Clayton H.S., about 50 km northeast of Marree (Fig. 1). The interval below 547 m was interpreted to be either weathered basement or Permian sediments. However, hydrogeological evidence suggested that the hole had not fully penetrated the Algebuckina Sandstone aquifer (Smith and Read, 1982).

In 1983, Clayton-2 was deepened to a total depth of 568 m with the aim of obtaining a core in unweathered basement. Coring was not possible because of inadequate circulation; however, samples of basement cuttings were collected for petrographic examination (see Appendix).

The deepening of Clayton-2 was carried out by M. Fosdike, assisted by F. Stummer and P. Moore, between 27th October and 12th November 1983, using a Portadrill RD2 rotary drilling rig. Geophysical logs were recorded by B. Traeger (Geophysical Services, SADME) on 9th November, 1983.

REGIONAL GEOLOGY

Clayton-2 is situated near the southwest margin of the Eromanga Basin, on the River Clayton, a major ephemeral creek that drains into Lake Eyre North. Late Cretaceous Winton Formation is exposed in the Hayes Hill area, 4-5 km upstream from the drill site, and this is overlain by silcreted Eyre Formation (Blanchewater and Murnpeowie Formations respectively of Forbes, 1966). "Greybilly" silcrete with ropy structure is seen in the riverbed adjacent to Clayton-2.

A basement high (the Muloorina Ridge) trends in a northwesterly direction through the area - this is assumed to consist predominantly of Adelaidean sediments extending in the subsurface from the northern Flinders and Willouran Ranges.

Mulooringa-1 well (see Fig. 1), 46 km west of Clayton-2, intersected a Mesozoic sequence overlying weathered laminated siltstone that resembles Tapley Hill Formation (B.G. Forbes, report in preparation).

STRATIGRAPHY AND BASEMENT LITHOLOGY

A final summary log of Clayton-2 is presented below in Table 1 (based on Smith and Read, 1982).

Table 1: Summary Log of Clayton-2
(estimated elevation 46 m AHD)

Unit	Interval (m)	Thickness (m)
Quaternary	0-5	5
Eyre Formation	5-17	12
Winton Formation	17-190	173
Oodnadatta Formation	190-304	114
Coorikiana Sandstone	304-319	15
Bulldog Shale	319-486	167
Cadna-owie Formation	486-526	40
Algebuckina Sandstone	526-548	22
Adelaidean	548-568+	20+

The basement samples consist of medium grey siltstone and a paler grey fine-grained dolomitic quartz sandstone. Both lithologies contain fine-grained muscovite or sericite, which imparts a fissile or platy structure to the siltstone. The two lithologies are presumably interbedded.

Petrographic descriptions of the samples are given in the appendix. Quartzitic textures in the sandstone and alignment of sericite flakes in the siltstone indicate a low grade of metamorphism which suggests an Adelaidean age for the basement. The metamorphism is presumably related to the Delamerian Orogeny.

The siltstone resembles the material described as micaceous siltstone or phyllite from Muloorina-1 (Farrand, 1983). Forbes (in prep.) has compared the siltstone in Muloorina-1 with Tapley Hill Formation. The Tapley Hill Formation in the northeast Willouran Ranges includes siltstone and coarse dolomitic sandstone (Forbes, 1966), a combination of lithologies comparable to those encountered in Clayton-2.

The upper part of the basement is deeply weathered to a white to purple-grey clay, presumably kaolinitic, and the effects of weathering extend to a depth of about 561 m. This gives an estimated thickness of about 13 m for the weathering profile, which may be related to the Palaeozoic Playfair Weathering Zone of Firman (1981).

GEOPHYSICS

The following geophysical logs were recorded for the interval between 500 m and the bottom of hole at 568 m: neutron; gamma; density; and caliper. Self potential, point resistivity, 16" and 64" normals were logged for the interval between 528 m and 568 m.

The geophysical logs indicate a Mesozoic/basement contact at 548 m.

CONCLUSIONS

Results from the deepening of Clayton-2 indicate a sequence of micaceous siltstone and dolomitic sandstone underlying Mesozoic sediments. Petrographic examination suggests an Adelaidean age for the basement. Similar basement was cored in

Muloorina-1, suggesting that the Muloorina Ridge is composed predominantly of Adelaidean sediments.

Deepening failed to intersect additional Jurassic aquifer material. An alternative explanation of upward vertical leakage of groundwater, to that proposed by Smith and Read (1982) in their interpretation of the aquifer tests, needs to be proposed.

Paul A. Rogers.

P.A. ROGERS
GEOLOGIST

REFERENCES

Farrand, M.G., 1983. Petrography of two fine-grained rocks from Muloorina-1 water bore, CURDIMURKA area. S. Aust. Dept. Mines and Energy report RB 83/103 (unpublished).

Firman, J.B., 1981. Regional Stratigraphy of the regolith on the southwest margin of the Great Australian Basin Province, South Australia. S. Aust. Dept. Mines and Energy report RB 81/40 (unpublished).

Forbes, B.G., 1966. The Geology of the Marree 1:250 000 map area. Rep. Invest., geol. Surv. S. Aust., 28.

Smith, P.C. and Read, R.E., 1982. Great Artesian Basin, report on Clayton No. 2 well. S. Aust. Dept. Mines and Energy report RB 82/27 (unpublished).

APPENDIX

Petrological Investigation of three percussion samples -
AMDEL report GS 6328/84 - Part II
by Don McColl.

PETROLOGICAL INVESTIGATION OF THREE PERCUSSION SAMPLES

1. INTRODUCTION

On 24 February 1984 three percussion chip samples were received at AMDEL from Dr B. Forbes of SADME. These samples are from the Clayton-2 water well on the Birdsville track, 50 km north of Marree, 1:100 000 Sheet No. 6539, RS numbers 18, 19, 20. These were the subject of a sample examination application received on 10 January 1984, but because of their later arrival are reported as Part II of AMDEL report GS 6328/84.

2. PROCEDURE

Because these samples consist of an assortment of rock chips all of which are very fine grained, each was prepared as a composite thin section for microscopic examination. This was somewhat difficult as all required impregnation and some were water active as well.

3. RESULTS

Sample RS 18 (Clayton-2, 556-559 m); TS 45354

Rock name:

Sericitic Siltstone; Dolomitic Sandstone

Hand Specimen:

This sample consists of five or six relatively coarse rock chips, which are all of rather different composition. All, however are sediments of relatively fine grain size, and most show at least a weak foliation and/or stratification of their components. The grain size of detrital components, and proportions of clays present in these samples varies considerably from one chip to another, and some are also grossly affected by water, tending to swell and disperse.

Thin Section:

Brief petrographic descriptions of the constituents are as follows,

Argillaceous Siltstone (Phyllite)

A quite fine grained silty sediment in which clay mineral is the principal component, and areas of almost pure argillite are mottled with areas of siltstone. The clay is possibly rather chloritic in composition and is permeated with a minor proportion of submicroscopic ?carbonaceous pigmentation. Small areas of greenish colouration suggests the former presence of glauconite. There is a weakly defined subparallel foliation of sericite throughout these chips, which probably indicates incipient metamorphism parallel to the former bedding direction. A few of the detrital mineral grains are feldspars, which occasionally show polysynthetic twinning, and there are also relict outlines of former micas partially absorbed into the argillaceous groundmass. This suggests relatively rapid sedimentation, in a basin of moderate depth with spasmodic turbulence to intraformationally brecciate the weakly lithified clay-siltstone phases.

Dolomitic Sandstone

A fairly fine grained, rather argillaceous sandy sediment, with detrital quartz grains near 0.2 mm diameter which are intermittently recrystallised into a quartzitic mosaic, but with many areas of clay mineral or interstitial fillings occupied by clays or anhedral angular grains of carbonate. The carbonate has not responded to the Alizarin red-S reagent used to indicate calcite, and from its light colour is concluded to probably be dolomite. The fragment had a few fine traces of carbonaceous veining, but is essentially leucocratic. Rare detrital grains of zircon of similar size to the quartz are dispersed throughout.

Sericitic Argillaceous Siltstone

This fragment contains about 40% of subangular silty quartz grains, enveloped in a matrix of sericitic clay mineral. Most of the detrital grains are less than 50) m diameter but spasmodic coarser and often quite angular quartz and quartzitic fragments may be up to 200) m, and occur randomly throughout the much finer matrix. This fragment contains a few rare grains of carbonaceous pigmentation but is also generally leucocratic.

It is difficult to evaluate the significance of the grain angularity in such fine detrital sediments, but the angularity of the coarser grains, coupled with the generally rather poor stratification and the quite abundant labile components within some fragments, seems to suggest that there may have been some material of pyroclastic derivation included within these fragments.

Sample 6539 RS 19 (Clayton-2, 559-562 m); TS 45355

Rock name:

Dolomitic Sandstone; Sericitic Siltstone; Quartz

Hand Specimen:

This sample consists of a large number of more medium sized rock and mineral chips. Most of the lithic fragments appear to be essentially of one type, but there is an appreciable proportion of finer discrete quartz grains.

Thin Section:

Brief petrographic descriptions of the constituents are as follows,

Dolomitic Sandstone

By comparison with the previous sample, fragments of fine carbonate sandstone are much more abundant in this section, and are generally composed of slightly coarser detrital quartz grains which are present in somewhat greater proportion than in the previous sample. These quartz grains still rarely exceed 0.3 mm diameter, and many of their grain boundaries are distorted into polygonal outlines in a typical quartzitic mosaic. There is a considerable proportion of detrital flakes (muscovite), forming part of the interstitial matrix and merging into the small patches of sericitic clays. These possibly comprise 20% of the rock, and alternate with an almost equal proportion of strained anhedral crystals of carbonate, which appear to have developed in situ, and enveloped some of the finer material. This carbonate is also inert to the Alizarin red-S reagent, and from its generally light colour is also assumed to be of dolomitic composition, as in the preceding sample.

A very few of these fragments differ by containing excessive quantities of carbonate, and would more appropriately be called dolomitic marl or silty dolomite.

Sericitic Siltstone

These fragments are virtually identical with the similar fragments described in the preceeding sample. They consist of about 40% of detrital silt-size quartz grains, and probably also a few sparse feldspars, set in a matrix of sericitic clay mineral and relict mica (muscovite) flakes variously altered and tending to merge into the clay-sericite matrix. Rare traces of ?carbonaceous staining or pigmentation tend to give these fragments an overall brownish colour. Although the detrital grains are somewhat rounded, there is virtually no traces of stratification and the relict mica flakes show no tendency toward any common alignment. This seems to suggest that sedimentation took place in a relatively turbulent environment, which has, however, produced no effective sorting or stratification within the resulting siltstone.

Quartz Grains

These are generally monomineralic single crystals of quartz, but with a few minor quartzitic composites, and rare grains which contain inclusions of muscovite, and in one case a moderately coarse flake of fresh biotite. These grains have dimensions up to 2 by 1 mm, and are generally much coarser than any of the detrital grains in the sandstone or siltstone fragments examined so far. They have quite rounded outlines, although in some cases showing embayed re-entrants, as though they have been rounded by corrosion rather than abrasion. Very rare grains even show traces of rounded detrital outlines buried under authigenic silica overgrowths, which suggests that they may have been derived from loosely consolidated coarser sandstones, in which siliceous cementation was only just beginning.

Sample 6539 RS 20 (Clayton-2, 565-568 m), Ts 45356

Rock name:

Sericitic Siltstone; Quartz; Dolomitic Sandstone

Hand Specimen:

This sample consists of even more numerous and finer grained rock and mineral chips than in either of the previous

samples. Most of the lithic fragments appear to be one type and are apparently more fine grained and siliceous than in the preceeding samples. Quartz as discrete grains is again very abundant.

Thin Section:

Brief petrographic descriptions of the constituents are as follows,

Sericitic Siltstone (?Phyllite)

This is again an essentially fine grained silty sediment in a matrix of sericitic clay mineral. The proportion of detrital silty sand grains is, however, possibly increased by comparison with the fragments described in the preceeding samples. Feldspar is also again probably a minor component, but among grains which are all less than 50) m diameter, these are difficult to distinguish with certainty. Many of these fragments show a matrix containing quite abundant relict mica (muscovite) flakes, and by contrast with the previous samples the majority of these show a parallel or subparallel alignment, which is probably a former bedding stratification. To some extent this texture is obscured by the presence of a parallel schistosity within the sericitic clay matrix, into which the muscovite outlines are tending to merge. Rare granules and vague staining of the matrix with ?carbonaceous material have imparted a faint brownish colouration.

Quartz Grains

Almost without exception these are well rounded single crystals of quartz, which are generally just less than 1 mm diameter, but are occasionally coarser. They are very similar to those in the previous sample, showing what appear to be corrosion outlines superimposed upon rounding by abrasion. Very few, however, appear to be composites and virtually none show traces of the overgrowths seen before. Rather they appear as a well rounded and sorted beach sand. There are also a large number of much finer (less than 0.1 mm) angular quartz fragments, which have almost certainly been formed by comminution of the larger grains during the drilling process.

Dolomitic Sandstone

Only one appreciable sized fragment of this rock is present in the section area, and there are also a few small carbonate-bearing chips. They match the materials described in the previous samples and it is almost certain that they are contaminants from higher in the drill hole.

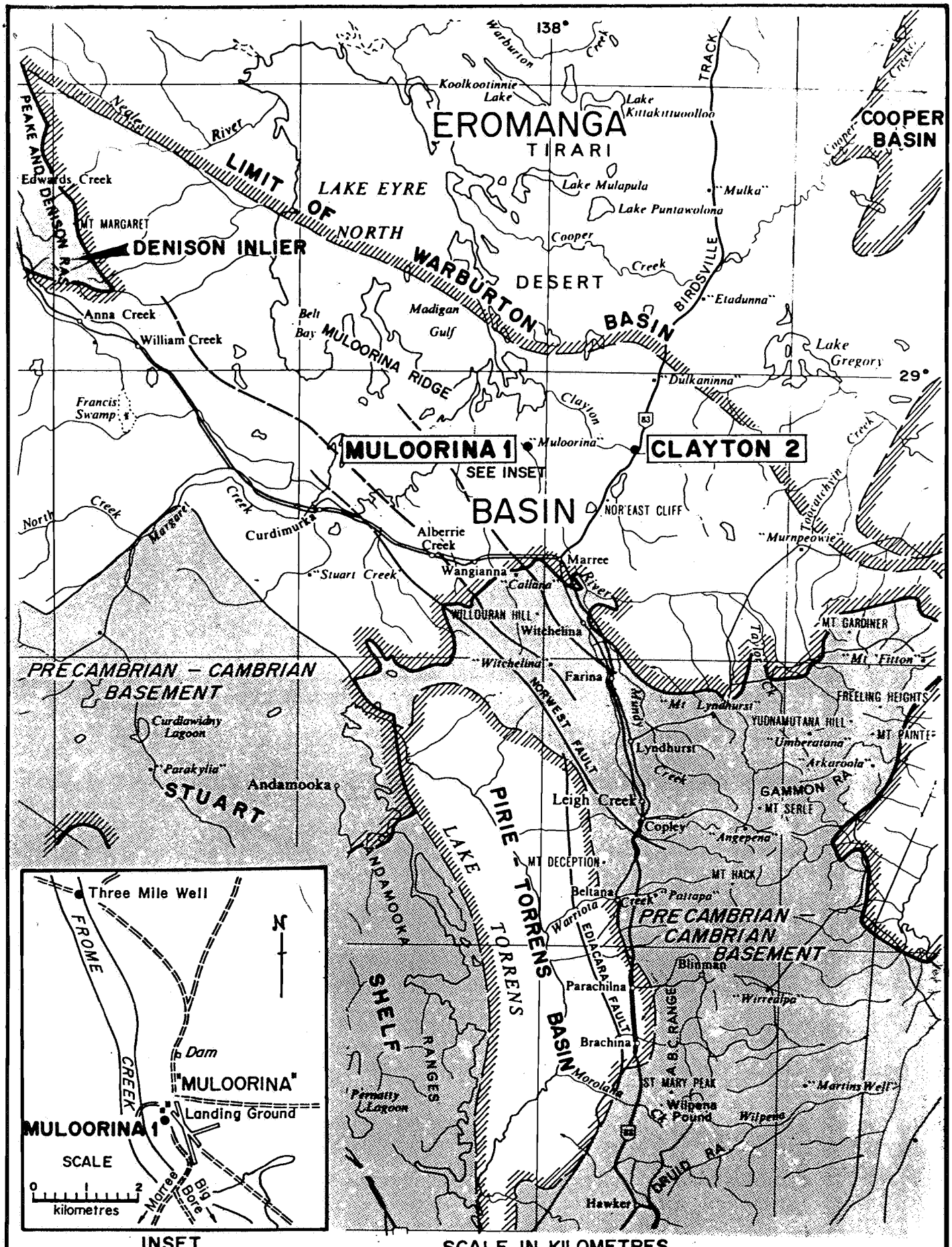

FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED B. G. FORBES | C D O | DATE

DRAWN E. C. | SCALE AS SHOWN

DATE JUNE 1984 | PLAN NUMBER

CHECKED | S 17365

MULOORINA 1 AND CLAYTON 2 WATER WELLS
LOCALITY PLAN

3560