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OODNADATTA TOWN BORE 2

WELL COMPLETION REPORT

R.C.N. THORNTON

Department of Mines
South Australia —

DEPARTMENT OF MINES
SOUTH AUSTRALIA

OODNADATTA TOWN BORE 2

WELL COMPLETION REPORT

by

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PETROLEUM GEOLOGY SECTION

with Appendix V by W.K. Harris and J.M. Lindsay

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5th September, 1974

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G.S. No. 5495
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WELL COMPLETION REPORT

ABSTRACT

Oodnadatta Town Bore 2 was drilled, at the request of the E. & W.S. Department, to supplement Oodnadatta's water supply. It was drilled to a total depth of 439.48 m with a 5-1/8" bit. It was reamed to 8" and then cased with 6" steel tubing to a depth of 413.72 m, just above the artesian aquifer. The flow rate of the bore, after pump testing, is 3.4 l/sec.

The bore intersected 415.5 m of marine to marginal marine Cretaceous sediments before intersecting the Neocomian Algebuckina Sandstone, which is the artesian aquifer. The Algebuckina Sandstone in Oodnadatta Town Bore 2 proved to be 50 m higher, 5 m thinner and considerably more shaley than in Bore 1, 1.4 km to the southwest. This may account for the relatively poor flow rate in the new bore.

The bore bottomed in steeply dipping, very hard quartzite of (?)Ordovician age and thus proved the absence of Permian sediments.

INTRODUCTION AND REASONS FOR DRILLING

The primary objective of the drilling was to provide a new water bore for Oodnadatta. The flow rate from the first bore, drilled in 1893, has progressively diminished over the last few years. As a result, the E. & W.S. Department requested that a new bore be drilled, firstly to increase Oodnadatta's water supply, and secondly to enable rehabilitation work to be carried out on the first bore.

The secondary objective was to increase our stratigraphic knowledge in the area. On being advised that the bore was to be drilled to the artesian aquifer, the Petroleum Exploration

Division requested that drilling be continued through to pre-Permian.

Oodnadatta is situated between two known Permian sedimentary basins, the Arckaringa Basin to the southwest and the Pedirka Basin to the northeast (Fig. 1). Only at one location, about 8 km to the northeast of Oodnadatta, had seismic shooting encountered intermediate refractors with typical Permian velocities, and drilling in the vicinity of the town had not completely disproved the existence of Permian sediments. The first bore did not completely intersect the aquifer sequence. However, the only other deep well in the area Santos Oodnadatta 1 (see Fig. 2 for location), sited about 8 km to the northwest, passed directly from Jurassic to (?)Ordovician sediments. Thus the primary question was whether or not Permian sediments, which elsewhere in the State contain hydrocarbons, existed in the region.

The other stratigraphic reason for deepening the bore was to identify the pre-Permian sequence. High speed seismic refractors correlatable with both (?)Devonian dolomite and (?)Ordovician quartzite had been identified in the region.

Oodnadatta Town Bore 2 spudded on 9 April 1974, took 46 days to drill and then ream to 8", and was completed as a water well on 5 June 1974 (Fig. 3). The drilling successfully achieved its objectives in that artesian water was produced, Permian sediments were found to be absent, and (?)Ordovician quartzites were intersected at 434 m. Total depth was 439.48 m.

WELL HISTORY

General Data

Well Name and Number

South Australian Department of Mines Oodnadatta Town Bore 2.

Location

Latitude : 27°32'35"

Longitude : 135°27'05"

The well is situated beside the water tower on the eastern side of Oodnadatta.

Map References

1:250 000 OODNADATTA

1:100 000 Oodnadatta

Details of Petroleum Tenement

The well was drilled within P.E.L.'s 5 and 6, held by Delhi International Oil Corporation and Santos Ltd.

Elevation

Rotary Table : 121.80 m

Ground Level : 120.81 m

Total Depth : 439.48 m

Date Drilling Commenced : 9 April, 1974

Date Drilling Completed : 24 May, 1974

Drilling Time to Total Depth : 46 days

Date Well Completed : 5 June, 1974

Date Rig Released : 5 June, 1974

Status : Completed as an artesian water well, flowing at a rate of 3.15 litres/sec. See Appendix VI for pump test results.

Drilling Data

Name and Address of Drilling Contractor

S.A. Department of Mines Mechanical and Drilling Branch, Dalgleish Street, Thebarton, S.A. 5031.

Drilling Rig :

Make	:	Failing 1500
Type	:	Rotary Drill
Rated Capacity	:	457.2 m with 2-3/8" drill pipe
Motor	:	Cummings Diesel
Power Rating	:	138 kW at 1800 R.P.M.

Mast :

Make	:	Failing 1500
Type	:	Open Front
Rated Capacity	:	10 909 kg

Pumps(2) :

Make	:	Gardner-Denver
Type	:	FGFXG
Size	:	12.7 x 15.2 cm
Motor	:	Cummings Diesel
Power Rating	:	31.7 kW

Hole Size :

	11-3/4"	to 5.35 m
	5-1/8"	to 435.50 m
Reamed	8"	to 413.72 m
	5-1/8"	to 437.67 m
	3.907"	to 439.48 m

Casing and Cementing Details :

Size	Weight	Grade	Depth
6"	18 kg/m - 309 m)	"High Tensile"	Set at 413.72 m
6"	23.5 kg/m-105 m)	steel tubing	

Casing was cemented from 410 m to surface with 200 sacks of Adelaide Blended Cement (20% pozzolanic fly ash) mixed with 5 500 litres of water.

Note: Some lost circulation was experienced during cementing.

Bit Record :

No. of bits used	Size	Type	Make
1	11-3/4"	Auger	S.A.D.M.
2	5-1/8"	4 Wing Blade	Bourne
1	5-1/8"	VH1	Varel
3	5-1/8"	VH2	Varel
1	5-1/8"	VH3	Varel
1	3.907"	Diamond Core	Mindrill
1	8"	Reamer	Bourne

Drilling Mud Materials :

Bentonite	25 sacks x 45 kg/sack
Myrtan	4 sacks x 23 kg/sack
Caustic Soda	26 kg
Quiktrol	10 kg
Diesel Oil	400 litres

The well was drilled with water to a depth of 176 m.

Water Supply :

Both drilling and camp water were obtained from Oodnadatta Town Bore 1.

Perforation Record :

No perforations were carried out.

Formation Sampling

Coring :

Three cores were cut, using a 3.408 m Mindrill stationary inner tube barrel and Mindrill face discharge bit. A fourth core was cut during fishing operations.

Core No.	Depth (m) From	To	Length Cored (m)	Recovery (m)	(%)	Core Size (inches)
Fishing Core	approx. 72		0.21	0.21	100	5-3/8
1	430.59	433.59	3.00	1.35	45	2-1/8
2	437.67	438.32	0.65	0.43	66	2-1/8
3	438.32	439.48	1.16	0.38	33	2-1/8
	TOTALS:		5.02	2.37	46	

Ditch Cuttings :

One sample was collected and preserved for every 5 m interval drilled from surface to 85 m, and every 2½ m interval between 85 m and 437½ m. Washed samples were examined under a binocular microscope (generally at a magnification of 30x) to determine percentage of cuttings. Samples below 400 m were also examined under ultra-violet light to detect any hydrocarbon fluorescence.

Sidewall Sampling :

None.

Storage of Samples :

Both the ditch cuttings and cores are stored at the S.A. Department of Mines Core Laboratory, Thebarton.

Water Sampling :

Water samples from the artesian aquifer were collected during pump testing. Analyses are contained in Appendix VII.

Logging and Survyes

All logging was carried out using the S.A. Department of Mines Failing Logmaster unit (914 m model).

Electrical and other Logging :

Log	Depth (m) From	To	Scale
Gamma-Ray	0	439	1:500
	380	439	1:200
Neutron-Neutron Run 1:	14	435	1:500
Run 2:	7	439	1:200
	380	439	1:200
Self Potential	14	435	1:500
Point Resistivity	14	435	1:500
16" Normal Resistivity	25	434	1:500
64" " "	25	432	1:500
6' Lateral "	16	434	1:500
Temperature	0	435	1:500

N.B. The depths in the above table are those from the logger and were measured from ground level. Logging was carried out at two different times, with the electrical and temperature logs being run prior to the drilling of cores 2 and 3.

Penetration Rate :

The penetration rate for every metre drilled was recorded by the driller and a graphic representation is included on the composite log (Enclosure 1).

Velocity Survey :

None.

Deviation Survey :

None.

Formation Testing

Pump Testing :

After completion, the bore was pump tested with a 3" Sykes pump in an attempt to clear sand from the aquifer and increase the flow. The pump test lasted four days. Before testing the artesian flow was 3.25 l/sec, and after testing the flow was 3.4 l/sec. Pump test details are contained in Appendix VI.

GEOLOGY

General

The sediments intersected at Oodnadatta Town Bore 2 were deposited in two depositional phases separated by a long period of non-deposition. The well bottomed in (?)Ordovician quartzites, whereas the overlying rocks were part of the Jurassic to Cretaceous Great Artesian Basin suite.

Hard quartzites have been encountered at Oodnadatta 1 (Fig. 2) and Weedina 1 (Papalia 1970), 100 km south of Oodnadatta. Because of lithological similarity they have been correlated with the Ordovician sequence which crops out in the eastern Officer Basin (Krieg, 1973). The Ordovician of the Officer Basin consists of four depositional units, a lower sandstone, a soft siltstone and two upper sandstones. In the lower unit, the Mt. Chandler Sandstone, the lower beds are hard, white, and quartzitic, and contain abundant *Scolithus* and U-shaped burrows. The upper beds are more reddish and slightly feldspathic. The Mt. Chandler

Sandstone has been tentatively correlated with the Pacoota Sandstone, which produces gas in the Palm Valley and Mereenie fields in the Amadeus Basin.

Oodnadatta lies on the northeastern margin of the Permian Arckaringa Basin, which is fully described by Townsend (1973).

The Algebuckina Sandstone is the oldest Great Artesian Basin rock unit encountered. It is defined (Wopfner *et al.*, 1970) as the formation of medium-grained to conglomeratic arenite beds unconformably overlying pre-Jurassic rocks and overlain, generally disconformably, by the Cadna-owie Formation.

In outcrop, the Algebuckina Sandstone generally is vivid white to very light grey because of the abundance of interstitial kaolin. In grain size it ranges from fine-grained sand to pebble conglomerate, and vertical and lateral changes are common. It is a freshwater, predominantly fluviatile deposit.

Deposition of the Cadna-owie Formation marked the onset of a marine transgression. In general, the sediments were laid down under shallow-water, marginal marine conditions. In detail, however, several specialised marginal-marine and brackish water environments are documented by the great variety of rock types which comprise this unit (Wopfner *et al.*, 1970).

In the type section the Cadna-owie Formation is dominantly a quartz sandstone, generally fine to medium grained and containing irregular gritty bands, pebbles and boulders in the lower part. In the upper part, fine to very fine grained sandstone dominates. It is typically feldspathic and mica flakes and carbonaceous flecks are common.

Overlying the Cadna-owie Formation in the Oodnadatta region is the marine Bulldog Shale. The gross lithology of the formation is dark grey shale which is fossiliferous, carbonaceous, glauconitic, silty, and pyritic. It contains grey, fine grained and silty concretionary carbonates which mainly form "cannon-balls" or flattened ellipsoids and are frequently fossiliferous (Freytag, 1966).

Following deposition of the Bulldog Shale, sediments of the Oodnadatta Formation were laid down. This unit consists primarily of silty shale and argillaceous siltstone,with the two often being intimately associated in disturbed sediment. Carbonates in the formation are mostly silty or sandy.

Within the Oodnadatta Formation, three arenitic members have been identified in outcrop (Freytag, 1966). At, or near the base is the Coorikiana Member, a fine grained, highly glauconitic (up to 50%) sandstone, which is feldspathic, lithic and calcareous in part. Near the middle of the Oodnadatta Formation, the Wooldridge Limestone Member consists mainly of siltstones, calcareous and sandy in part, with numerous ellipsoidal carbonate concretions. Ammonites are commonly abundant. The Mount Alexander Sandstone Member occurs near the top of the formation and is a very fine grained, glauconitic sandstone, containing some shaley siltstones in the upper portion.

These members of the Oodnadatta Formation have all been identified at Oodnadatta 1 (Freytag, 1966), and Townsend (1971) recognised the lower two at Yardinna 1 (Fig. 2).

The township of Oodnadatta is built on the Pleistocene-Recent, gypsite land surface (Freytag, *et al.*, 1967).

Stratigraphic Table

AGE	FORMATION	SUBSURFACE DEPTH (m)	SUBSEA ELEVATION (m)	THICKNESS (m)
Recent - Quaternary	Un-named	0	+121	8
Albian	Oodnadatta Formation	8	+113	141
	Coorikiana Sandstone Member	117	+4	32
Aptian-Albian	Bulldog Shale	149	-28	241
Neocomian-Aptian	Cadna-owie Formation	390	-269	25.5
Neocomian	Algebuckina Sandstone	415.5	-294.5	18.5
(?)Ordovician	Un-named	434	-313	5.48+
TOTAL DEPTH		439.48	318.48	

Stratigraphy

N.B.: For a more complete description of the various formation lithologies see Appendix I.

Un-named (Quaternary - Recent) Depth Interval : 0 - 8 m

The Quaternary - Recent material consists dominantly of clay, which is either pale yellow-grey, soft and sticky, or red, ferruginised and slightly harder. There are a few thin sand bands.

Oodnadatta Formation (Albian) Depth Interval : 8 - 149 m

Above the Coorikiana Sandstone Member, the Oodnadatta Formation is primarily a clay unit with very minor sand and carbonate bands.

There are two types of clay which occur interbedded in approximately equal amounts. The first of these is dark grey, soft (becoming more indurated with depth), carbonaceous and highly glauconitic. The glauconite consists of dark green spherical and rounded pellets of very fine to fine grain size. The pellets tend to occur in aggregates, some of which are micaceous. Most of them disintegrate easily, but a few are cemented by pyrite.

The other clay type is dominantly very pale grey and silty.

Coorikiana Sandstone Member (Albian) Depth Interval : 117-149 m

The Coorikiana Sandstone is a greensand with minor interbeds of silty clay. The greensand is composed of glauconite pellets, silt to very fine grain size, together with quartz and minor feldspar grains of the same dimensions, and a little mica. The matrix normally comprises 5% of the rock and is dark grey clay or in a few cases carbonate.

Bulldog Shale (Aptian-Albian) Depth Interval : 149-390 m

The Bulldog Shale is mainly a dark grey silty shale which becomes progressively more silty with depth, until siltstone dominates. There are minor bands of sandstone and carbonate.

The shale is dark grey, silty, in part slightly calcareous, and carbonaceous, pyritic, micaceous and glauconitic. The percentage of quartz silt is normally 5-10%, but in a few cases reaches 50%. The other clastics generally total about 5%, although concentrations of each occur, especially along bedding planes. Both pyrite and glauconite frequently occur as aggregates.

Although shale bands do occur in the lower 100 m of the section, they are subordinate to grey or grey-brown siltstone. The major clastic component is quartz (50-80%), then glauconite (10-15%), then pyrite, often as aggregates.

Other clastics are feldspar, mica, and carbonaceous matter.

Sandstone bands comprise mainly quartz and glauconite set in either a grey clay or clear calcite matrix. There are indications of bimodality in some of the sandstone, with quartz tending to be silt to very fine grained and glauconite pellets very fine to fine grained.

The carbonate bands are generally very hard, 25-50 cm thick, and consist of brown to green-brown (?) calcian siderite (Appendix IV), finely to coarsely crystalline, with inclusions of quartz, glauconite, mica, and pyrite. However, clear fibrous calcite also occurs and seems to be vein filling material.

Cadna-owie Formation (Neocomian-Aptian) Depth Interval: 390-415.5 m

The Cadna-owie Formation consists of siltstone to very fine grained, buff sandstone, containing about 5% coarser grains, many of which are granules. The dominant mineral is quartz, with minor amounts of feldspar, pyrite, mica, glauconite, and carbonaceous material.

The matrix is generally a soft, calcareous clay (up to 25%) but occasional thin, hard bands of sandstone cemented by carbonate occur.

At the base of the formation there exists a sandstone made up primarily of quartz and (?) chamosite ooids (Appendix IV) in varying proportions from nearly pure quartz to nearly pure ooids. The matrix is hard, green-brown carbonate (? siderite). The ooids are mostly spherical, with blue-grey and brown rings. They are ¼-1 mm in diameter with nucleii of quartz, feldspar grains, or occasionally pyrite.

Algebuckina Sandstone (Neocomian) Depth Interval: 415.5-434 m

The upper part of the Algebuckina Sandstone consists of sandstone interbedded with shale. The sandstone varies from buff and loosely consolidated to grey-brown and well cemented. It comprises very poorly sorted, very fine to medium grained quartz in a green clay matrix. The shale is dark grey, slightly silty, calcareous and micaceous.

The lower part of the section is dominated by sand, although there are also shale bands similar to the upper part. The sand is quartzose, coarse grained to granular, with occasional pebbles, and is unconsolidated.

Un-named (?Ordovician) Depth Interval: 434-439.48 m

This un-named unit is a very hard, pale blue quartzite, consisting of clear quartz with minor chalcedony and feldspar. The clastics are dominantly well sorted, fine grained and cemented by silica. Bedding, shown by very thin (less than 1 mm) dark grey shale bands, dips at 45°-50°.

RESULTS AND DISCUSSION OF GEOLOGICAL SEQUENCE

Results

The primary objective of drilling, to provide another water bore for Oodnadatta, was achieved. However, the flow rate after pump testing (3.4 l/sec) was considerably less than that from Oodnadatta Town Bore 1 when it was completed in 1895 (14.7 l/sec). In addition, the wellhead pressure is considerably less in the second bore than it ought to have been by comparison with the old bore. It is possible that pump testing has not satisfactorily cleaned the aquifer, thus inhibiting the free flow of the water (D.S. Stanley, pers. comm.). Pump test details are listed in Appendix VI. It is possible, however, that the poor flow rate is due to a thinner and more shaley section in the second bore (see Discussion). Although the flow rate is not as good as had been anticipated, it should be sufficient, when augmented by pumping, for Oodnadatta's needs.

The water quality of the two bores is virtually identical. A sample taken from Bore 2 during the final flow period of the pump testing had a salinity of 1790 mg/l (Appendix VII), compared with 1766 mg/l for a sample collected from Bore 1 in 1963.

The secondary drilling ovjective, to identify the pre-Mesozoic sequence, was also achieved. Permian sediments were found to be absent, and the well bottomed in (?)Ordovician quartzite. Regrettably, these quartzites fractured along steeply dipping shale partings whilst being cored, thus jamming the core barrel and preventing further drilling. Only a few centimetres of core, therefore, were recovered from Cores 2 and 3 (Appendix III).

Discussion

Shale partings in the basal quartzite were examined for the existence of palynomorphs, but were found to be barren. However, on lithological evidence the quartzite is dated as (?)Ordovician by comparison with the Officer Basin sequence (Krieg, 1973). The importance of the Ordovician suite of rocks as potential hydrocarbon reservoirs is discussed by Devine and Youngs (1973 and 1975). Suffice it to say that the identification of these sediments provides one more known locality in an important, but very sparsely drilled area.

The lack of Permian sediments at Oodnadatta is a strong indication that the Arckaringa and Pedirka Basins are not now connected in the region between Oodnadatta and the north of the Peak and Denison Ranges. This interpretation is shown by Devine and Youngs (1975) who suggest that the Muloorinna Ridge (Fig. 1) extends northwestwards from the Peak and Denisons, with Oodnadatta sited near the centre of the ridge. They suggest that connection between the two basins may exist to the northwest of Oodnadatta.

Certainly the existence of a structural feature in the immediate vicinity of Oodnadatta is shown by the fact that the elevation of the Mesozoic/(?)Ordovician unconformity is 50 m higher in Bore 2 than the presumed elevation in Bore 1, 1.4 km to the southwest (Fig. 2). In addition, the fact that the quartzite in both Oodnadatta 1 and Oodnadatta Bore 2 are steeply dipping, compared with the flat lying sediments in Weedina 1, suggests a zone of considerable structural uplift.

Not only is the Algebuckina Sandstone in Bore 2 up dip to that in Bore 1, but the section is also considerably

thinner. It is probable that drilling virtually penetrated the complete aquifer sequence in Bore 1, so that the thickness is estimated at 23 m (Fig. 2). The thickness in Bore 2 is 18 m. The sequence in the second bore also appears to contain considerably more shale than in the first, at the expense of the coarse, unconsolidated sand which is the good aquifer. Oodnadatta Bore 2 presumably, therefore, intersected more of a lacustrine facies, which Wopfner *et al.* (1970) noted existed in some sections of the upper part of the Algebuckina Sandstone. It is important that in Bore 2 the Algebuckina Sandstone has been dated as Neocomian.

The Cadna-owie Formation sequences in the two Oodnadatta bores are similar. The most noticeable difference is that the chamositic oolite horizon occurs right at the base in Bore 2 and 3 m above it in Bore 1. Presumably this is due to onlap up dip.

Deposition of the Bulldog Shale appears to have eradicated any significant variations in relief in the Oodnadatta region, as shown by the fact that the top of the formation is at the same elevation in the two bores (Fig. 2).

Identification of the members within the Oodnadatta Formation proved difficult in Oodnadatta Bore 2, so that the boundaries picked are fairly tentative. However, the interpretations are not contradicted by palaeontological evidence (Appendix V). The difficulty in identification in the subsurface is well illustrated by the core recovered during fishing operations at approximately 72 m. This olive green, glauconitic sandstone looks identical to some of the facies of the Coorikiana Sandstone Member as mapped in outcrop (L.C. Barnes *pers. comm.*). It is, however, too young to be Coorikiana Formation (Appendix V), and this raises the question as to whether the Coorikiana Sandstone Member as mapped is always Coorikiana Sandstone Member.

The core from approximately 72 m also looks very much like core material identified as Mount Alexander Sandstone Member in Oodnadatta 1 (L.C. Barnes, *pers. comm.*). Unfortunately, Oodnadatta 1 was not electrically logged, so no comparison can be made between lithology and log response. On the logs from Oodnadatta Town Bore 2 there is no significant indication of a sandstone unit in the region of 72 m, and thus the Mount Alexander Sandstone Member cannot be identified. In all probability the fishing core intersected a thin sandstone band.

The top of the Cretaceous section appears to be 8 m below ground level, and is overlain by clays of the gypsite land surface (Heath *et al.*, 1967).

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5th September, 1974
RCNT:IA

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PETROLEUM GEOLOGY SECTION

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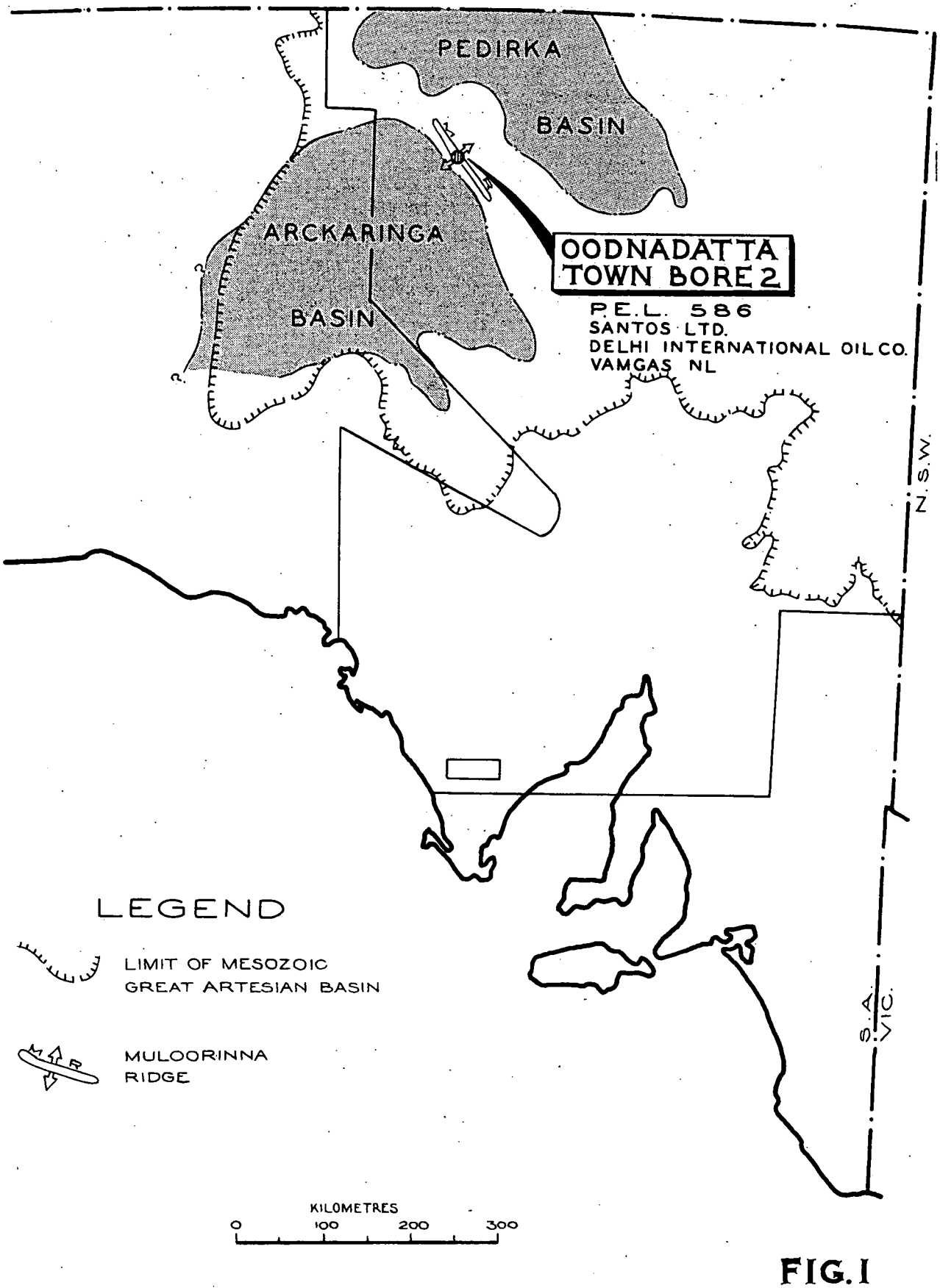

FIG. 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA

PETROLEUM GEOLOGY SECTION	Drn. R.T.	OODNADATTA TOWN BORE 2 LOCALITY MAP	SCALE: AS SHOWN
R.C.N. Thornton GEOLOGIST	Tcd. AR		S11034 Bd
	Ckd. A.F.		DATE: 19TH AUG. 1974
	Exd.		

500—2.69 665

A P P E N D I X I

RECONSTRUCTED LITHOLOGIES

RECONSTRUCTED LITHOLOGIES

Un-named (Quaternary - Recent)

Depth Interval: 0 - 8 m Thickness: 8 m

0 - 8 m CLAY, either yellow-grey, soft, sticky; or red, ferruginised and slightly harder than yellow-grey, slightly silty; minor sand bands.

Oodnadatta Formation (Albian)

Depth Interval: 8 - 149 m Thickness: 141 m

8 - 27.5 m CLAY, yellow, orange-grey, blue-grey, red, silty, slightly carbonaceous, with minor silt bands; and:
SANDSTONE, quartz, clear, fine grained, cemented with either silica or ferruginous (red) matrix.

27.5 - 72.5 m CLAY, dark grey, very soft, slightly silty, carbonaceous, (abundant minute flecks).

72.5 - 117 m Approximately equal amounts (interbedded) of:
CLAY, dark grey, very soft-soft (becoming more indurated with depth), carbonaceous, highly glauconitic. Glauconite ranges from 5-50% near the base, and consists of dark green pellets with high sphericity, very fine-fine grained and subround. The pellets tend to occur in 1-2 mm aggregates, some of which are micaceous (speckled bronze), most of which easily break up; but some are cemented by pyrite. Aggregates of quartz silt cemented with pale yellow iron also occur, and some are very hard.
CLAY, very pale grey, yellow, pink, pale brown, orange, silty. Silt is quartz, clear subround-wellrounded, low-high sphericity.

Minor amounts of:

CARBONATE, pale buff, pale green, green-brown, hard, containing silt-sized inclusions of glauconite and quartz.

117 - 149 m — Coorikiana Sandstone Member (Albian)

GREENSAND, dark green glauconite pellets, silt-very fine grain size, mostly medium sphericity and subround; together with clear quartz and minor feldspar grains of the same dimensions and matrix; very small flakes of mica (speckled red) set in a dark grey clay matrix. Minor carbonate (?calcian siderite). Difficult to estimate ratio of glauconite: quartz, about 50:50. Most of the sand has only 5% dark grey clay matrix, but some shows gradation to very silty, dark grey clay.

Interbeds of:

CLAY, very pale grey, pink, yellow, pale khaki, medium hard, silty (5-15%, mostly 10%). Silt is quartz, clear, medium sphericity, subround-round and minor glauconite pellets. Yellow colouration, due to iron staining, is accompanied by hardening of the rock.

Bulldog Shale (Aptian - Albian)

Depth Interval: 149 - 390 m Thickness: 241 m

149 - 200 m — CLAYSTONE - SILTSTONE, dark grey, ranging from silty claystone to clayey siltstone depending on the amount of silt. Silt is fine, clear

quartz. Usually up to 5% carbonaceous, pyritic and micaceous material disseminated throughout; but some claystone is quite highly pyritic with concentrations of finely crystalline pyrite occurring along bedding planes.

Minor interbeds, at least 2 mm thick, of:

GREENSAND, dark green glauconite pellets and clear quartz (ratio 50:50), fine to very fine grained, medium sphericity, loosely cemented together.

CLAYSTONE, dominantly (80%) very pale grey, also yellow, pink, pale purple, brown; silty (up to 25%, mainly 5-15%). Silt is quartz, clear, subround, medium sphericity; with a few grains as large as fine grained sand and polished.

200 - 227 m SHALE, dark grey, silty, with up to 5% mica, pyrite and carbonaceous material finely disseminated throughout. Silt is normally 5-10%, but in a few cases is up to 50%. Silt grains mostly clear quartz with minor concentrations of highly spherical dark green glauconite.

Thin beds of:

CARBONATE, either (?)calcian siderite, pale green, green-brown, finely crystalline, very hard, with minor inclusions of carbonaceous material, glauconite and pyrite; or calcite, clear to pale green, fibrous with parallel oriented rods, 1 x 0.05 mm, with quartz grains and other rock material at each end.

227 - 241.5 m SANDSTONE, clear quartz and dark green glauconite, together with minor amount of pyrite. Glauconite ranges from 40-90%. Matrix ranges from 0-50%, and is either grey shale or clear calcite. Some of the sandstones are probably bimodal. Quartz tends to be silt-very fine grained, subangular-subrounded, low to medium sphericity; glauconite very fine-fine grained, subrounded-well rounded, medium-high sphericity. Minor bands of SHALE and CARBONATE as for 200 - 227 m.

241.5 - 298 m SHALE, dark grey, silty, slightly carbonaceous, pyritic (occasionally up to 25%), micaceous (up to 3%), carbonaceous (often occurring as flakes along bedding planes) and glauconitic (occasionally up to 15%). Sometimes concentrations of glauconite pellets one pellet thick occur along bedding planes).

Partly gradational with minor interbeds of:

SILTSTONE, grey; clear, coarse quartz silt (up to 60%), glauconite pellets, pyrite, carbonaceous material, mica in clay matrix.

The colour of the shale-siltstone depends on the percentage silt and is gradational one to the other.

Occasional bands of:

CARBONATE, brown, very hard, coarsely crystalline, slightly pyritic and carbonaceous.

298 - 390 m

SILTSTONE, grey, grey-brown, comprising varying amounts of medium-coarse quartz silt, glauconite (often coarser than quartz), feldspar, pale blue and orange grains, pyrite, mica, and carbonaceous material. Generally well sorted. Major clastic component is quartz (50-80%), then glauconite (10-50%), then pyrite (often as aggregates). Average clastic content = 75%. Gradational with minor interbeds of:

SHALE, dark grey, silty, slightly harder than the siltstone, slightly calcareous; comprising varying amounts of mainly very fine quartz silt and very finely disseminated mica, carbonaceous material and pyrite (sometimes up to 70%). Pyrite often occurs in small aggregates. Well rounded glauconite pellets occur as minor medium grained sand size concentrations. Average clastic content = 20%.

Occasional bands of:

CARBONATE, (?)calcian siderite, pale brown, green-brown, very hard, finely crystalline, containing up to 25% very fine grained sand size, dark green glauconite pellets, quartz silt, carbonaceous material and finely disseminated pyrite.

Cadna-owie Formation (Neocomian - Aptian)

Depth Interval: 390 - 415.5 m Thickness: 25.5 m

390 - 412 m SILTSTONE - SANDSTONE, pale buff, very loosely consolidated; silt-very fine grained quartz, predominantly clear, but minor pale blue, green, tourquoise and yellow. Low-high sphericity, angular-rounded, generally well sorted, but containing about 5% coarser grains of clear quartz, often granules and generally well rounded. Minor amounts of feldspar, pyrite, mica, glauconite, and carbonaceous material. Matrix is generally soft, calcareous clay, comprising up to 25% of the rock.

Minor bands of brown to green-brown sandstone occur, and are well cemented by carbonate.

412 - 415.5 m SANDSTONE, brown to blue-grey, quartz, chamosite ooids and minor feldspar, in varying proportions from nearly pure quartz to nearly pure ooids, set in a hard green-brown carbonate (?siderite) matrix (25-35%). Quartz is clear, angular-round, medium-high sphericity, very poorly sorted, very fine-medium grained. Ooids are mostly spherical, outer colour blue grey, pale blue, green, with blue-grey and brown rings; ¼ - 1 mm diameter, with nucleii of quartz or feldspar grains, and minor pyrite.

Algebuckina Sandstone (Neocomian)

Depth Interval: 415.5 - 434 m Thickness: 18.5 m

415.5 - 422.5 m SANDSTONE, pale buff and loosely consolidated, to green-brown and hard; very poorly sorted, very fine to medium grained quartz, angular-rounded, with a green clayey matrix (30%). Interbedded with:

SHALE, dark grey to grey-brown, containing fine quartz silt with tiny carbonaceous flecks, glauconite and trace amounts of mica.

Un-named (?Ordovician)

Depth Interval: 434 - 439.48 m Thickness: 5.5+ m

QUARTZITE, white, pale blue (dominant), blue-green, mainly clear quartz, minor chalcedony and feldspar, very minor dark grains; dominantly well sorted, fine grained (very minor poorly sorted; fine-medium grained); low to mainly high sphericity, subangular to well rounded, mostly subrounded-rounded. Very minor white clay matrix (5%). Very hard, cemented by silica. Bedding, shown by very thin (<1 mm) dark grey shale bands, dips at 45-50°.

A P P E N D I X I I

DITCH CUTTINGS DESCRIPTIONS

DITCH CUTTINGS - DESCRIPTIONS

All samples were examined wet, under a binocular microscope, normally with 30x magnification. Colours were described for the wet sample. Grain size determination was from the Wentworth scale; roundness and sphericity from Powers.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
0 - 5	100	Clay	Pale yellow, grey, soft, sticky, non-calcareous.
	Trace		Clay, red, ferruginous, slightly harder than grey; quartz grains, fine - med. grained.
5 - 10	100	Clay	Yellow, grey (66%) red (34%) silty, soft, sticky.
	Trace		Gypsum, clear, platy.
10 - 15	100	Clay	Blue-grey (minor orange & red), with small carbonaceous flecks interspersed throughout.
15 - 20	100	Clay	Yellow and orange-grey, silty (5% of total), harder than above; minor fragments of dark grey, hard clay.
20 - 25	100	Clay	a.a.
25 - 30	98	Clay	Very pale grey, slightly silty and soft (70%); dark grey, carbonaceous, slightly silty and soft (20%); red ferruginous claystone, slightly harder than the others (10%). Very minor yellow, orange, and pink clay.
	2	Sandstone	Quartz, clear, fine grained, cemented with either silica or iron (and thus red) matrix.
30 - 35	100	Clay	Mainly (80%) very soft, dark grey, slightly silty clay; minor (20%) soft, very pale grey, slightly silty, clay; very minor yellow, orange, pink clay.
	Trace		Sandstone a.a.
35 - 40	100	Clay	a.a.
	Trace		Claystone, med. hard to hard, silty, yellow to green-brown, ferruginous.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
40 - 45	100	Clay	a.a.
45 - 50	100	Clay	Mainly (80%) dark grey, very soft (easily removed by washing), carbonaceous (abundant very small flecks) very slightly silty. 20% clay, soft, slightly silty, very pale grey, yellow, pink, pale brown, orange. Silt is clear quartz.
50 - 55	100	Clay	a.a.
55 - 60	100	Clay	a.a.
	Trace		Gypsum, large, clear, crystalline fragments.
60 - 65	100	Clay	a.a. Quartz content in dark grey clay is virtually absent and too fine grained to be silt. Silt content in other clays is 5-10%.
	Trace		Gypsum.
65 - 70	100	Clay	a.a.
	Trace		Glauconite pellets, dark green, high sphericity, subrounded, very fine to fine grained; gypsum.
70 - 75	100	Clay	Mainly (80%) dark grey, very soft (easily removed by washing), carbonaceous (abundant very small flecks); glauconitic, containing approx. 5% pellets, dark green, high sphericity, subrounded, very fine to fine grained - glauconite tends to occur in 0.5 - 2 mm aggregates, most of which easily break up. Some, however, are cemented by pyrite. 20% silty clay, very pale grey, yellow, pink, pale brown, orange; silt-quartz, clear, subrounded-well rounded, low-high sphericity.
	Trace		Limestone, pale buff, hard, dissolves fairly readily in dil. HCl (10%), containing abundant silt sized inclusions, some of which are glauconite pellets, others colourless (quartz?). Quartz aggregate, coarse grain size, consisting of silt-sized grains, well cemented, in part by pyrite.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
75 - 80	100	Clay	a.a., except that proportion is 50% dark grey, 50% other colours, of which very pale grey (off-white) dominates. Pyrite not obvious in glauconite aggregates.
	Trace		Ironstone, red, golden colour, very fine grained pyrite and(?) haematite chips, hard.
80 - 85	100	Clay	a.a., except 60% very pale grey; 40% dark grey.
	Trace		Ironstone a.a.; gypsum.
85 - 87½	98	Clay	60% very pale grey a.a.; 40% dark grey a.a., except rather less glauconite.
	2	Gypsum	Large clear plates.
	Trace		Limestone, clear, clayey matrix; ironstone a.a.
87½- 90	98	Clay	a.a.
	2	Gypsum	a.a.
	Trace		Limestone, very pale green, comprising aggregates of silt-sized, highly spherical, well rounded grains - (?)ooids; ironstone a.a.
90 - 92½	100	Clay	50% very pale grey a.a.; 50% dark grey a.a.
	Trace		Gypsum a.a.; ironstone a.a.; limestone, pale green to green-brown, finely crystalline, hard, some containing glauconite pellets; mica.
92½- 95	100	Clay	20% very pale grey (buff) + orange pink, brown, yellow; silty, with other inclusions (fragments of different coloured clay ?), moderately hard. Silt is clear quartz. 30% dark grey clay, carbonaceous (but rather less than above) moderately hard, containing glauconite pellets in 0.5 - 1 mm aggregates - pellets are dark green, very fine to fine grained, normally high sphericity, subrounded. This is the same as very soft dark grey clay above, but more indurated.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
			50% pale grey, very soft clay. Occurs as a mass and original cuttings shape has disappeared. Covers the cuttings, making visibility difficult; contains silt, glauconite, etc. Presumably residue from drilling water, removed with washing.
	Trace		Large, well-rounded, clear quartz grains; limestone, a.a.; ironstone a.a.; large flakes of pale green mica.
95 - 97½	100	Clay	50% very pale grey, etc. a.a. 50% dark grey a.a.; except about 50% of this is glauconite aggregates, some containing tiny flakes of mica with a speckled bronze colour, and also silt grains. Also some silt size quartz aggregates, cemented with pale yellow iron. Perhaps also, a little very finely disseminated pyrite in clay.
	Trace		Quartz a.a.; limestone a.a.; ironstone a.a.
97½-100	100	Clay	50% very pale grey, etc. a.a.; 50% dark grey, a.a.
	Trace		Quartz grains, coarse-grained, med. sphericity, subrounded, clear; limestone a.a.; ironstone, a.a.
100 - 102½	100	Clay	50% very pale grey, etc. a.a.; 50% dark grey a.a., except mica not observed in glauconite aggregates.
	Trace		Quartz a.a.; ironstone a.a.
102½-105	100	Clay	60% very pale grey, etc. a.a.; 40% dark grey a.a.
	Trace		Quartz a.a.; ironstone a.a. - this is very well cemented quartz aggregate as for 95-97½; limestone, a.a.
105-107½	100	Clay	50% very pale grey, etc. a.a.; a few cuttings containing minor amounts of glauconite; 50% dark grey a.a.
	Trace		Ironstone a.a.; limestone a.a.
107½-110	100	Clay	a.a.
	Trace		Ironstone a.a. (up to 1-2%), much of it bright red, crystalline (?) pyrite; limestone a.a.; coarse grained, clear quartz grains, med. sphericity, subrounded, some with pyrite on them; large flakes of clear gypsum.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
110-112½	100	Clay	50% very pale grey, etc. a.a.; 50% dark grey a.a.
	Trace		Gypsum a.a.; limestone a.a.
112½-115	100	Clay	a.a.
	Trace		Limestone a.a.
115-117½	100	Clay	a.a.
	Trace		Limestone a.a.
117½-120	100	Clay	a.a.
	Trace		Limestone a.a.; ironstone, ranging from hard yellow/red cement enclosing quartz grains to virtually pure iron.
120-122½	60	Clay	a.a.
	40	Greensand	Virtually all the dark grey clay consists of glauconite aggregates and there is rather more silt sized quartz in these aggregate, which contain very small flakes of mica.
	Trace		Limestone, a.a.; gypsum.
122½-125	60	Clay	a.a.
	40	Greensand	a.a.
	Trace		Limestone a.a.
125-127½	75	Clay	85% very pale grey, pink, yellow, pale khaki green, med. hard, silty- silt is quartz, clear, med. sphericity, subrounded; also glauconite pellets of the same shape and size as well as other coloured (mostly white and orange) inclusions. Silt varies 5-10% mostly 10%. Yellow colour, due to iron staining is accompanied by hardening of the rock. 15% dark grey, carbonaceous, med. hard, containing glauconite pellets; silt - very fine grain size, mostly med. sphericity and sub-rounded, very slightly silty.
	25	Greensand	Glauconite pellets as described for the clay, together with clear quartz grains of the same dimensions set in a dark grey clay matrix. Difficult to estimate ratio of glauconite: quartz, probably approx. 50:50. N.B. These are the glauconite aggregates as previously described.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
127½-130	50	Clay	Very pale grey, etc. a.a., except more silty - up to 25% silt.
	40	Greensand	a.a. very small flakes of mica, with a speckled red colour occur in the sand. Most of the sand has only about 5% clay matrix but some show a gradation to very silty dark grey clay.
	10	Clay	Dark grey a.a.
130-132½	50	Greensand	a.a.
	40	Clay	Very pale grey, etc. a.a.
	10	Clay	Dark grey a.a.
	Trace		Limestone, green-brown, crystalline, hard, containing inclusions of glauconite pellets.
132½-135	55	Greensand	a.a.
	40	Clay	Very pale grey, etc. a.a.
	5	Clay	Dark grey a.a.
	Trace - 1%		Limestone a.a., also some highly glauconitic and silty - looks like calcite cemented greensand.
135-137½	55	Greensand	a.a. - Quartz grains range from 50-75%.
	40	Clay	Very pale grey, etc. a.a.
	5	Clay	Dark grey, a.a.
	Trace		Limestone a.a.
137½-140	60	Greensand	a.a.
	40	Clay	Very pale grey etc. a.a.
	Trace		Limestone a.a.; dark grey clay a.a.
140-142½	70	Clay	Very pale grey, etc. a.a.; silt content up to 10%.
	25	Greensand	a.a.
	5	Clay	Dark grey a.a.
	Trace		Limestone.
142½-145	75	Clay	Very pale grey etc. a.a. - very pale grey comprises 80%.
	20	Greensand	a.a.
	5	Clay	Dark grey a.a.
	Trace		Gypsum.
145-147½	75	Clay	Very pale grey etc. a.a.
	20	Greensand	a.a.
	5	Clay	Dark grey a.a.
	Trace		Limestone.
147½-150	95	Clay	Very pale grey etc. a.a., including some purple.
	5	Greensand	a.a. some of it virtually pure quartz.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
150-152½	60	Clay	Pale khaki green, moderately hard, no inclusions.
	30	Clay	Very pale grey etc. a.a.
	5	Clay	Dark grey a.a.
	5	Greensand	a.a.
152½-155	30	Clay	Very pale grey, etc. a.a.
	25	Clay	Dark grey a.a.
	25	Greensand	a.a.
	20	Clay	Pale khaki green, a.a.
	Trace		Quartz grains, well rounded, med. sphericity, clear, polished, some with iron cement; gypsum.
155-157½	50	Clay	Pale khaki, green, a.a.; cuttings tend to be larger than other clays.
	20	Clay	Very pale grey, etc. a.a.
	15	Greensand	a.a.
	15	Clay	Dark grey a.a.
	Trace		Quartz a.a.
157½-160	30	Clay	Pale grey, etc. a.a.
	25	Greensand	a.a.
	25	Clay	Dark grey, a.a., except about 30% consists of slightly paler very fine silt (i.e. clayey siltstone). The more silty cuttings are not as carbonaceous as the less.
	20	Clay	Pale khaki green a.a.
	Trace		Gypsum, large, well rounded fragment .
160-162½	40	Clay	Very pale grey, etc. a.a.
	25	Greensand	a.a.
	25	Clay/ Siltstone	Dark grey clay and clayey siltstone, a.a. except that they contain a few pale green, silt-sized, well rounded and spherical grains.
	10	Clay	Pale khaki green a.a.
	Trace		Gypsum a.a.
162½-165	38	Claystone	Very pale grey, yellow, pink, silty (approx. 80% very pale grey)-silt comprises up to 25%, mainly 5-10%; silt-quartz clear, subrounded, med. sphericity; a few grains as large as fine grained and polished.
	35	Claystone	Dark grey, silty claystone and clayey siltstone (in proportion 70:30). Both carbonaceous (up to 3%) and slightly micaceous (very fine grains). Silt is fine quartz, clear. Very minor amounts of pyrite in the clay. A few of the carbonaceous fragments are 0.5 mm long.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
	20	Clay	Pale khaki green, no inclusions; cuttings larger than others.
	5	Greensand	Glauconite pellets and clear quartz (ratio 50:50) fine to very fine grained, med. sphericity, rounded, loosely cemented together.
	2	Gypsum	Clear to milky, large platy fragments.
	Trace		Pyrite aggregates, finely crystalline.
165-167½	50	Silty Claystone	Very pale grey, etc. a.a.
	30	Silty Claystone	And clayey siltstone (90:10), dark grey, a.a., except slightly glauconitic.
	10	Clay	Pale khaki a.a.
	8	Greensand	a.a. except ratio of glauconite: quartz often 10:90.
	2	Gypsum	a.a.
167½-170	55	Silty Claystone	Very pale grey, etc. a.a.; with bright green grains (see below).
	20	Silty Claystone	Dark grey a.a., some containing fine grain sand size, well rounded, high sphericity, light, bright green grains. Slightly glauconitic. Carbonaceous matter occurs as flakes delineating bedding planes.
	20	Greensand	a.a. A few cuttings indicate that the glauconitic silty claystone is interbedded with the greensand, with bands of greensand at least 2 mm thick.
	5	Clay	Khaki a.a.
170-172½	55	Silty Claystone	Very pale grey, etc. a.a.
	20	Silty Claystone	And clayey siltstone (80:20), dark grey a.a.
	20	Greensand	a.a.
	5	Clay	Khaki a.a.
	Trace		Quartz grains, clear, but each grain coated with yellow iron stain; med.-coarse grained, subangular-round, med. sphericity; limestone, pale grey, clayey, glauconitic and carbonaceous, hard.
172½-175	55	Silty Claystone	Very pale grey, etc. a.a.
	20	Silty Claystone	Clayey siltstone (70:30), dark grey a.a.; quite a few cuttings contain light bright green grains, a.a.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
	20	Greensand	a.a. except some very fine grained sand with virtually no glauconite, instead grains coated with yellow stain.
	5	Clay	Khaki a.a.
175-177½	50	Silty Claystone	Very pale grey, etc. a.a.
	40	Silty Claystone	And clayey siltstone (90:10), dark grey a.a., some of the siltstone is well cemented and very hard.
	10	Clay	Khaki a.a.
	Trace		Quartz a.a. with yellow coating - forms hard sandstone.
177½-180	60	Silty Claystone	And clayey siltstone (90:10), dark grey a.a.
	20	Silty Claystone	Very pale grey, etc. a.a.
	18	Clay	Khaki a.a.
	2	Limestone	Green-brown, crystalline with carbonaceous inclusions, very hard-cuttings occur as sharp angular chips. Contains very thin clear calcite veins.
	Trace		Quartz a.a. including some with bright red coating; highly indurated black shale.
N.B. Limestone band: 178.0-178.2 m			
180-182½	40	Silty Claystone	And clayey siltstone (90:10), dark grey a.a., except a few bright green grains in claystone and mica in siltstone.
	40	Silty Claystone	Very pale grey, etc. a.a.
	20	Clay	Khaki, a.a.
	Trace		Quartz a.a. grains very fine-fine grained.
182½-185	50	Silty Claystone	Very pale grey, etc. a.a.
	30	Silty Claystone	Dark grey a.a.
	20	Clay	Khaki a.a.
	Trace		Limestone a.a.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
185-187½	50	Silty Claystone	Very pale grey, etc. a.a.
	30	Silty Claystone	And clayey siltstone (90:10),dark grey a.a. Some of the claystone is highly pyritic, with concentrations of finely crystalline pyrite occurring along bedding planes. Some of the claystone forms a breccia of angular blocks of claystone, coarse grained in size, and with different composition with respect to % silt, etc., with a soft, yellow (?iron rich) clay matrix.
	20	Clay	Khaki, a.a.
	Trace		Limestone a.a.; fine grained sandstone comprising very loosely cemented grains of well rounded and spherical, clear quartz grains.
187½-190	50	Silty Claystone	Very pale grey, etc. a.a.
	40	Silty Claystone	And clayey siltstone (90:10), dark grey a.a. including very minor breccia.
	9	Clay	Khaki a.a.
	1	Greensand	Quartz and glauconite, fine grained, subrounded-well rounded, med. sphericity.
	Trace		Limestone, a.a.
190-192½	60	Silty Claystone	And clayey siltstone (80:20), dark-grey a.a.
	20	Silty Claystone	Very pale grey, etc. a.a.
	20	Clay	Khaki a.a.; on the whole cuttings are rather larger and more well rounded than others.
192½-195	60	Silty Claystone	Dark grey, a.a.
	25	Silty Claystone	Very pale grey, etc. a.a.
	15	Clay	Khaki , a.a.
	Trace		Gypsum, clear to milky, large fragments.
195-197½	70	Silty Claystone	Dark grey, with up to 5% mica, pyrite, carbonaceous material finely disseminated throughout. Percentage silt is normally about 5-10%, but in a few cases up to 50%. Silt grains mostly clear quartz, with minor concentrations of well-rounded and highly spherical dark green glauconite.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
	20	Silty Claystone	Very pale grey, pale purple, pink, yellow, brown. Slightly softer than dark grey and cuttings more rounded. Silt generally 15-20%. Silt grains mostly clear quartz, with minor coloured grains.
	8	Clay	Pale khaki-green, softer than other two, forming large rounded cuttings.
	2	Gypsum	Clear to milky, large cuttings.
	Trace		Limestone brown to green-brown, crystalline, very hard, with some inclusions including a few glauconite grains. Quartz sandstone, quartz med. grained, angular, med., sphericity, clear, cemented by yellow matrix, fairly hard. Ironstone, bright red, finely crystalline, very hard.
197½-200	50	Silty Claystone	Dark grey a.a. except some is indurated enough to form large flakes, thus shale.
	45	Silty Claystone	Very pale grey etc. a.a.
	5	Claystone Breccia	Predominantly med. grained angular blocks of dark grey, but also very pale grey, intermixed. Loosely cemented by clay matrix, often yellow, otherwise very pale grey.
	Trace		Gypsum, a.a.; quartz sandstone a.a., except grain size varies from silt to med. grained.
200-202½	80	Silty Shale	Dark grey a.a. with some large angular flakes.
	19	Silty Claystone/ Clay	Very pale grey, etc. Both form generally larger and more rounded cuttings than shale.
	1	Limestone	a.a.
	Trace		Calcite vein, clear rods of calcite 1 x .05 mm, with quartz grains and other rock material at each end. Pyrite aggregate-finely crystalline.
N.B. Actual Lithology is probably dark grey shale with thin bands of limestone. The claystone and clay are contaminants.			
202½-205	60	Silty Shale	Dark grey a.a.; in quite a few cases finely pyritic.
	40	Silty Claystone/ Clay	Very pale grey, etc. large rounded cuttings.
	Trace		Gypsum, pale green, large rounded fragments.
205-207½	70	Silty Shale	Dark grey a.a.
	28	Silty Claystone	Very pale grey etc.
	2	Limestone	a.a.
	Trace		Calcite, very hard yellow-green fragment.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
207½-210	85	Silty Shale	Dark grey a.a.
	13	Silty Claystone	Very pale grey, etc. a.a.
	2	Limestone	a.a.
210-212½	90	Silty Shale	Dark grey a.a.
	10	Silty Claystone	Very pale grey, etc. a.a.
	Trace		Limestone a.a.
212½-215	90	Silty Shale	Dark grey a.a.
	9	Silty Claystone	Very pale grey, etc. a.a.
	1	Clayey Siltstone	To fine grained sandstone; clear quartz cemented by silica and yellow or red iron. The finer the clastics, the more firmly cemented; hardness ranging from very hard to loosely consolidated.
	Trace		Ironstone, finely crystalline, red, yellow, very hard. Pyrite chips.
215-217½	60	Limestone	50% pale green, green-brown, finely crystalline, very hard, minor inclusions of (?)carbonaceous material, (?)glauconite, pyrite. 50% clear to pale green, fibrous "roddy" calcite, hard, rods 1 x 0.05 mm and parallel. The two types grade into one another.
	40	Silty Shale	Dark grey a.a.; some of it quite highly pyritic (5%). Percentage of silt up to approx. 10%, mostly approx. 5%.
	Trace		Granule of red stained, well rounded, highly spherical quartz. Ironstone a.a.; pyrite a.a.
217½-220	95	Silty Shale	Dark grey, a.a.; pyritic.
	5	Limestone	a.a.
	Trace		Silty claystones and clay, a.a.
220-222½	98	Silty Shale	Dark grey a.a.
	2	Limestone	a.a.
	Trace		Silty claystones and clay a.a.
222½-225	100	Silty Shale	Dark grey a.a.
	Trace		Limestone a.a.; silty claystones a.a.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
225-227½	100	Silty Shale	Dark grey. About half the cuttings show the presence of pyrite (up to 5%) either finely disseminated, or along bedding planes, or in 0.25 mm concentrations. Many of the cuttings form very large (up to 2 cm long) flakes.
	Trace		Limestone a.a.; silty claystones a.a.
227½-230	95	Silty Shale	Dark grey a.a., slightly carbonaceous.
	5	Sandstone	75% quartz, 25% glauconite, fine-med. grained, well sorted, well polished, subangular to well rounded, high sphericity, minor clay matrix (clay matrix ranges from nearly 0% to about 25%, mostly 5%), fairly well consolidated, some pyritic.
	Trace		Silty claystones, a.a.
230-232½	90	Silty Shale	Dark grey a.a.
	10	Sandstone	a.a.
	Trace		Silty claystones a.a.
232½-235	95	Silty Shale	Dark grey a.a.
	5	Sandstone	a.a., minor amounts cemented with red iron matrix.
	Trace		Silty claystones a.a.
235-237½	55	Sandstone	Clear quartz and dark green glauconite, together with minor amounts of pyrite and a few pale green grains of glauconite dimensions. Percentage glauconite ranges from 40-90%. Matrix ranges from 0-50% and can be either grey shale or clear calcite. There are indications of bimodality in some of the sandstone chips: quartz tends to be silt-very fine grained, subangular-subrounded, low to med. sphericity; glauconite tends to be very fine-fine grained, subrounded-well rounded, med.-high sphericity.
	40	Silty Shale	Dark grey: finely pyritic (up to 5%), minor carbonaceous material and very minor small mica flakes and glauconite grains (these three total about 5%); silt is very fine, clear quartz at about 5%.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
	5	Calcite	Clear to pale green, fibrous or roddy (rods 2 x 0.03 mm); grades into the sandstone and in part acts as a cement.
	Trace		Pyrite aggregate; limestone a.a.
237½-240	95	Shale	Dark grey a.a.
	5	Sandstone	a.a.
	Trace		Calcite a.a.; limestone a.a.
240-242½	80	Shale	Dark grey a.a.
	20	Sandstone	a.a., except some comprises almost pure quartz, either very fine grained sand - coarse silt or very fine silt, with virtually no matrix.
	Trace		Calcite a.a.; pyrite aggregate.
242½-245	100	Shale	Dark grey a.a.
	Trace		Calcite a.a.; siltstone, clear quartz.
245-247½	100	Shale	Dark grey a.a., some highly pyritic (up to 25%).
	Trace		Pyrite aggregates; siltstone a.a., pyritic.
247½-250	100	Shale	Dark grey a.a.
	Trace		Calcite a.a.; siltstone a.a.
250-252½	100	Shale	Dark grey a.a., except pyrite not so abundant and some chips quite highly micaceous (up to 2-3%) with brown, speckled mica flakes.
	Trace		Calcite a.a.
252½-255	95	Shale	Dark grey a.a., except some chips contain up to 50% very fine silt.
	5	Sandstone	a.a., highly glauconitic and pyritic.
	Trace		Calcite a.a.
255-257½	100	Shale	Dark grey a.a., most chips contain up to 10% of combined silt, and finely disseminated carbonaceous material and pyrite.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
257½-260	90	Shale	Dark grey a.a., slightly calcareous, with very minor concentrations of glauconite grains; grading to:
	10	Siltstone	Grey, clayey; slightly paler than shale, containing just over 50% quartz silt in shale matrix. Contains varying amounts (up to 10%) of finely disseminated pyrite and carbonaceous material. The colour of shale-siltstone depends on the percentage of silt and is therefore gradational from one to the other.
	Trace		Pyrite aggregate; white-pale yellow clay.
260-262½	80	Shale	Dark grey a.a., except more silty-on average about 25% fine silt.
	20	Siltstone	Grey, a.a., slightly micaceous.
	Trace		White-pale yellow clay.
262½-265	95	Shale	Dark grey a.a., except not so silty, but finely disseminated pyrite is more abundant. It is very difficult to estimate percentage of the clastic fraction in the shale because it is very fine grained.
	5	Siltstone	Grey a.a.
	Trace		White-pale yellow clay.
265-267½	90	Shale	Dark grey a.a., containing on average 25% combined of fine quartz silt, pyrite, mica, carbonaceous material in varying proportions. Slightly calcareous.
	10	Siltstone	Grey a.a.
	Trace		White-pale yellow clay.
267½-270	90	Shale	Dark grey a.a.; very minor concentrations of glauconite grains.
	10	Siltstone	Grey a.a., very minor coarse silt with 10% glauconite grains.
	Trace		White-pale yellow clay.
270-272½	95	Shale	Dark grey a.a.
	5	Siltstone	Grey a.a.
	Trace		White-pale yellow clay.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
272½-275	95	Shale	Dark grey a.a.
	5	Siltstone	Grey a.a.
	Trace		White-pale yellow clay.
275-277½	90	Shale	Dark grey a.a., in part slightly calcareous. The carbonaceous material often occurs as flakes along bedding planes. Concentrations of glauconite pellets one pellet thick also occur along bedding planes.
	10	Siltstone	Grey a.a.; quartz varies in size from fine-coarse silt.
	Trace		White-pale yellow clay.
277½-280	90	Shale	Dark grey a.a.
	10	Siltstone	Grey a.a.
	Trace		White-pale yellow clay, white clay with yellow blotches (iron stained areas?) slightly silty.
280-282½	95	Shale	Dark grey a.a., except average clastic content about 10%. A few chips are highly (15%) glauconitic.
	5	Siltstone	Grey a.a., some more glauconitic than normal.
	Trace		Calcite, yellow; sandstone, fine grained quartz, clear, cemented with yellow iron matrix.
282½-285	95	Shale	Dark grey a.a., except no highly glauconitic chips.
	5	Siltstone	Grey a.a., except no highly glauconitic chips.
	Trace		White-pale yellow clay a.a.; grey-brown limestone, very hard, carbonaceous.
285-287½	90	Shale	Dark grey a.a., except average clastic content is about 25%.
	10	Siltstone	Grey a.a.
	Trace		Pyrite aggregate; clear calcite.
287½-290	80	Shale	Dark grey a.a., except average clastic content is about 5%.
	20	Siltstone	Grey a.a.; coarse quartz silt up to 40%, glauconite pellets, pyrite, carbonaceous material, mica and pale green grains in clay matrix; grading to pure quartz silt with calcite cement.
	Trace		Limestone, hard, fawn colour; yellow calcite.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
290-292½	80	Shale	Dark grey a.a.
	20	Siltstone	Grey a.a.
	Trace		White-pale yellow clay a.a.; pyrite aggregate.
292½-295	90	Shale	Dark grey a.a., except average clastic content is about 10%.
	10	Siltstone	Grey a.a.
	Trace		White-pale yellow clay a.a.; limestone, dark brown, very hard.
295-297½	90	Shale	Dark grey a.a.
	10	Siltstone	Grey a.a.
	Trace		White-pale yellow clay a.a.; with some dark grey patches (claystone breccia previously). White-pale yellow clay is perhaps leached dark grey shale.
N.B. Hard band:		297.50-297.75	Limestone, very hard, brown, coarsely crystalline, slightly pyritic and carbonaceous.
297½-300	95	Shale	Dark grey a.a.
	5	Siltstone	Grey a.a.
	Trace		Limestone, grey-brown, very hard, crystalline, pyritic; pyrite aggregate.
300-302½	80	Shale	Dark grey, medium hard, slightly calcareous, containing predominantly finely disseminated silt grains, small mica flakes, pyrite, and carbonaceous material. Silt is quartz, clear, normally very fine, but some coarse. Shale also contains trace amounts of fine grained and rounded bright green grains. The clastics vary considerably, but average 10%. Shale is gradational with:
	20	Siltstone	Grey to dark grey, clear to white quartz, mainly fine mica, pyrite in varying amounts, up to 80%, carbonaceous material, dark green glauconite grains (well rounded and normally coarser than quartz), bright green grains, set in shale matrix in varying proportions. Clastics range from 50% to nearly 100%.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
302½-305	60	Shale	Dark grey a.a. - one chip shows graded bedding from fairly clean siltstone to shale over distance of 5 mm.
	40	Siltstone	Grey a.a.
	Trace		Limestone a.a.; chips of hard yellow, dense material.
305-307½	70	Siltstone	Grey a.a., containing trace amounts of silt sized pale blue grains.
	30	Shale	Dark grey a.a.
	Trace		Pyrite aggregates.
307½-310	70	Siltstone	Grey a.a.
	30	Shale	Dark grey a.a.
	Trace - 1%		Pyrite aggregates.
310-312½	90	Siltstone	Grey a.a.
	10	Shale	Dark grey a.a.
	Trace		Pyrite aggregates.
312½-315	90	Siltstone	Grey a.a., mostly fine, minor amounts of coarse silt, containing white, orange and blue grains together with quartz, pyrite, mica, carbonaceous material. Clastics average 75%.
	10	Shale	Dark grey a.a.
	Trace - 1%		Pyrite aggregates; clear gypsum.
315-317½	60	Siltstone	Grey a.a.; average clastic content is 65%.
	40	Shale	Dark grey a.a., except average clastic content is 40%.
	Trace		Pyrite aggregates.
317½-320	70	Siltstone	Grey a.a., minor accumulations of fine grained sand size bright green glauconite pellets.
	30	Shale	Dark grey a.a.
320-322½	90	Siltstone	Grey a.a., abundant accumulations of bright green glauconite pellets ranging in size from fine to medium grained sand.
	10	Shale	Dark grey a.a.
322½-325	90	Siltstone	Grey a.a., except only minor amounts of glauconite.
	10	Shale	Dark grey a.a.
	Trace		Pyrite aggregates.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
325-327½	70	Siltstone	Grey a.a.
	30	Shale	Dark grey a.a.
	Trace		Pyrite aggregates; white shell fragments.
327½-330	80	Siltstone	Grey a.a.
	20	Shale	Dark grey a.a.
	Trace		Limestone, green-brown, very hard, finely crystalline, pyritic.
330-332½	90	Siltstone	Grey a.a.
	10	Shale	Dark grey a.a.
332½-335	60	Shale	Dark grey a.a.
	35	Siltstone	Grey a.a.; slightly paler and softer than shale.
	5	Claystone	Yellow-orange, very hard, silty-quartz.
335-337½	60	Shale	Dark grey a.a.
	35	Siltstone	Grey a.a.
	3	Claystone	a.a.
	2	Limestone	a.a.
	Trace		Shell fragment; pale yellow-brown silty shale in sharp, wavy contact with dark grey silty shale-leached?; pyrite aggregates.
337½-340	60	Siltstone	Grey a.a., except glauconite pellets rather more abundant.
	40	Shale	Dark grey a.a.
	Trace		Claystone a.a.
340-342½	90	Siltstone	Grey a.a., except average clastic content 75% and highly glauconitic (up to 80% of total clastics).
	10	Shale	Dark grey a.a.
	Trace		Calcite, pink; claystone a.a. to fine grained yellow sand-stone, quartz in hard clay matrix; clear gypsum.
342½-345	95	Siltstone	Grey a.a.
	5	Shale	Dark grey a.a.
	Trace		Claystone a.a., yellow, orange and pink, very hard; pyrite aggregate.
345-347½	60	Siltstone	Grey a.a., except rather less glauconite (average: 15% of total clastics).
	40	Shale	Dark grey a.a.
	Trace		Claystone a.a., silty and very hard.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
347½-350	95	Siltstone	Grey a.a., except highly glauconitic. Average clastic content is 65%, of which about 50% is glauconite. Glauconite and quartz silt both medium size and rounded.
	5	Shale	Dark grey a.a.
	Trace		Claystone a.a.
350-352½	60	Shale	Dark grey, moderately hard, containing varying amounts of very fine quartz silt, and very finely disseminated mica, carbonaceous material and pyrite (pyrite can be up to 70%). Pyrite also occurs in small aggregates. Minor concentrations of medium grained sand, well rounded glauconite pellets. Clastics average 20%. Gradational with:
	37	Siltstone	Grey, slightly paler and softer than the shale, comprising varying amounts of medium to coarse quartz silt, glauconite, white, pale blue and orange grains, pyrite, mica and minor carbonaceous material. Generally well sorted. Major clastic component is quartz (generally 50-80%), then glauconite (10-15%), then pyrite. Average clastic content = 70%.
	3	Claystone	White, pale yellow, pink, soft, slightly silty.
	Trace		Claystone, yellow hard.
352½-355	70	Shale	Dark grey a.a., except average clastic content = 30%.
	30	Siltstone	Grey a.a.
	Trace		Claystone, soft a.a.
355-357½	70	Siltstone	Grey a.a.
	30	Shale	Dark grey a.a. Chip showing pale yellow-brown shale in sharp, wavy contact with dark grey - bleached?
	Trace		Claystone, soft a.a.; claystone, hard, a.a.
357½-360	60	Shale	Dark grey a.a.
	35	Siltstone	Grey a.a.
	3	Limestone	Green-brown, crystalline, very hard, silty and carbonaceous, containing varying amounts of clastics, up to 50%.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
	1	Limestone	Pale brown, finely crystalline, very hard, no inclusions.
	1	Siltstone	Pale brown, very hard, clean, medium grained quartz silt, sub-rounded, well sorted, closely packed, cemented by calcite (no more than 5%).
N.B. Hard band at 358.5 (samples collected from drill bit)			Limestone, pale brown, finely crystalline, very hard, containing 25% very fine grained sand size, dark green glauconite pellets and minor finely disseminated pyrite. And Siltstone, pale brown, very hard, clear, medium quartz silt, subrounded, well sorted, closely packed, with minor carbonaceous material and calcareous cement (no more than 5%).
360-362½	59	Siltstone	Grey a.a.
	40	Shale	Dark grey a.a.
	1	Limestone	Brown, very hard, finely crystalline slightly silty.
362½-365	70	Shale	Dark grey a.a.
	30	Siltstone	Grey a.a.
	Trace		Limestone, pale brown, finely crystalline very hard, no inclusions; calcite, yellow and clear with fibrous orange staining; claystone, yellow, soft.
365-367½	70	Siltstone	Grey a.a.
	30	Shale	Dark grey a.a.
367½-370	70	Siltstone	Grey a.a.
	30	Shale	Dark grey a.a.
370-372½	60	Shale	Dark grey a.a.
	40	Siltstone	Grey a.a.
372½-375	70	Shale	Dark grey a.a.
	30	Siltstone	Grey a.a.
	Trace		Pyrite aggregate enclosing clear quartz grains varying in size from fine to very coarse grained and from well-rounded to angular.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
375-377½	80	Shale	Dark grey a.a.
	19	Siltstone	Grey a.a.
	1	Pyrite	Aggregates, one chip containing 50% fine-coarse clear quartz grains, mostly subrounded-rounded.
	Trace		Orange stained calcite.
377½-380	70	Shale	Dark grey a.a.
	30	Siltstone	Grey a.a.
380-382½	80	Shale	Dark grey a.a.
	20	Siltstone	Grey a.a., except most consists of almost pure, very fine, clear quartz silt, with only very minor amounts of other clastics or matrix. This rock is dark grey-brown.
382½-385	70	Siltstone	Grey-brown a.a.
	30	Shale	Grey a.a.
	Trace		Pyrite aggregates.
385-387½	70	Shale	Dark grey a.a.
	28	Siltstone	Grey-brown a.a.
	2	Pyrite	Aggregates.
387½-390	70	Shale	Dark grey a.a.
	28	Siltstone	Grey-brown a.a.
	2	Limestone	As described below for hard band at 389.
	Trace		Pyrite aggregates; calcite, pale pink radiating fibrous crystals, cross-section of belemnite guard, with radius of 3 mm.
N.B. Hard band at 389			Limestone, silty, clayey, pale khaki, very hard, comprising very fine silt sized calcite crystals, in clayey and finely silty, calcareous matrix. Sparite = 60%. Trace of mica. And: Limestone, pale brown, very hard, finely crystalline.
390-392½	70	Shale	Dark grey a.a.
	30	Siltstone	Grey-brown a.a.; minor amounts in fact comprise fine grained sand quartz grains, and minor glauconite, subangular-rounded, medium sphericity.
	Trace		Limestone, pale brown a.a., pyrite aggregates.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
392½-395	90	Siltstone	Buff, with tiny red-brown streaks, hard, comprising predominantly coarse, clear quartz grains, together with white, pale blue, green, turquoise grains (2-5%), subangular to rounded; generally well sorted but minor amounts of coarse grains (up to fine grained sand) interspersed in the silt. Trace amounts of mica and carbonaceous material. Matrix is clayey and calcareous and makes up about 25% of the rock.
	10	Shale	Dark grey a.a.
395-397½	90	Siltstone	a.a., except some of the chips comprise very fine-fine grained sandstone. Hardness of the rock varies considerably from loosely to well consolidated (on washing a disproportionate amount of the former is removed). One chip has a surface covered by a very thin powder blue layer.
	10	Shale	Dark grey a.a.
	Trace		Limestone, a.a.; pyrite aggregates a.a.
397½-400	100	Sandstone	Pale buff, very loosely consolidated comprising very fine grained quartz, predominantly clean but with minor yellow staining, low-high sphericity subangular-rounded, generally well sorted, but containing about 5% clear quartz, coarser grains often granules, generally well rounded. Trace amounts of mica. Matrix is soft clay and comprises 25-40% of the rock.
N.B. Hard band at 400			Siltstone a.a. Also: Sandstone, brown to green-brown, hard, clear quartz, very poorly sorted, silt to granule, angular to well rounded, low to high sphericity, trace amounts of mica; set in a clayey calcareous matrix, comprising 20% of the rock. Perhaps the sandstone was dominant, because the drill bit bounced excessively.

N.B. Fluoroscope was in use from 400 to Total Depth. Lack of mention means there was no fluorescence.

DEPTH(m)	%	CONSTITUENTS	DESCRIPTION
400-402½	100	Siltstone	Pale buff, very loosely consolidated and disintegrates on washing (consequently very difficult to remove drilling mud, and thus difficult to estimate clastic-matrix ratio). Comprises virtually all medium silt sized, clear quartz with minor pyrite, mica, carbonaceous flecks, yellow grains; generally well sorted, but containing up to 5% well rounded, coarser grains of clear, unpolished quartz, many of them granules. Clay matrix = 25-40% of the rock.
402½-405	80	Siltstone	To very fine grained sandstone, buff, very hard, predominantly quartz, with minor yellow and blue grains, carbonaceous flecks, mica, glauconite, with occasional coarse quartz grains interspersed (5%); calcareous clayey matrix = 25-40%.
	10	Siltstone	Off white, very hard, virtually pure fine quartz silt cemented by calcite (10% of rock).
	10	Sandstone	Pale buff, very poorly sorted, comprising clear quartz, angular to subrounded, low to high sphericity, silt to granule, medium (breaks between fingers) to well consolidated, calcareous clayey matrix comprising 20% of rock.
N.B. Each of these three rock types probably have unconsolidated equivalents (due to less calcite) removed by washing. The rock types are also probably largely gradational.			
405-407½	60	Sand	Clean, milkv, pale green, pale pink, very coarse grained, occasional granule, subangular-rounded, medium-high sphericity, not well polished. Loose, but probably originally contained in very soft, pale buff, silty, clay matrix.
	40	Siltstone	To very fine grained sandstone, a.a., except very poorly consolidated.
	Trace		Pyrite cementing coarse quartz sand grains.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
407½-410	60	Sand	a.a.
	40	Siltstone	To very fine sandstone a.a., with minor hard chips.
	Trace		Pyrite.
410-412½	80	Siltstone	To sandstone, pale buff, poorly sorted, silt-fine grained, with minor (5%) coarser grains, predominantly clear quartz, with minor orange, yellow and blue grains and glauconite (in a few cases concentrations - up to 75% of glauconite), sub-angular-rounded, medium-high sphericity; clayey matrix (about 25% of rock). Unconsolidated to moderately consolidated.
	20	Sand	a.a.
412½-415	60	Sandstone	Brown to blue-grey, quartzose and oolitic, in varying proportions from nearly pure quartz to nearly pure ooids, set in hard green-brown limonite matrix (up to 20%). Quartz, clear, angular-rounded, medium-high sphericity, very poorly sorted, very fine-medium grained. Ooids mostly spherical, outer colour blue-grey, pale blue, green, with blue-grey and brown rings, limonite and minor pyrite cores, 0.25-0.5 mm diameter. About 25% of chips are strongly oolitic.
	30	Sand	a.a.
	5	Limonite	Brown, red-brown, yellow, very hard, finely crystalline.
	3	Pyrite	Usually enclosing clear quartz grains, fine to coarse grained, angular-rounded.
	2	Siltstone	Pale buff, almost pure, clear quartz, well consolidated.
415-417½	69	Sandstone	Brown, minor yellow, clear quartz, poorly to well sorted, silt to medium grained, angular-rounded, low-high sphericity. Hard limonite matrix (10-30%). Trace amounts of mica and carbonaceous flecks.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
	20	Sandstone	Oolitic a.a.
	10	Sand	a.a.
	1	Pyrite	a.a., including some containing ooids as in sandstone.
	Trace		Siltstone a.a.
417½-420	50	Sandstone	Pale buff, very poorly consolidated (original shape of chips eradicated) to slightly consolidated. Clear quartz, very fine-medium grained, angular-rounded, in pale grey clay matrix.
	40	Shale	Dark grey, calcareous, slightly silty and micaceous.
	5	Sand	a.a.
	5	Siltstone	a.a.
420-422½	45	Sandstone	Pale buff a.a.
	40	Shale	a.a.
	5	Sandstone	Green-brown, hard, clear quartz, very poorly sorted, very fine-medium grained, angular-rounded, cemented by green, clayey matrix (30%).
	5	Sand	a.a.
	4	Siltstone	a.a., calcareous.
	1	Pyrite	
422½-425	50	Sand	Quartz, clear, milky, pale pink and blue, coarse grained-granule, dominantly very coarse grained, subangular-well rounded, medium-high sphericity, not well polished, unconsolidated.
	30	Shale	a.a.
	20	Sandstone	Pale buff, clear quartz, very poorly sorted, very fine-coarse grained, subangular-rounded, minor (up to 10%) glauconite, trace biotite, well cemented by off-white, calcareous, clayey matrix (10-20%).
425-427½	80	Sand	a.a., except some of the well rounded grains are polished.
	10	Shale	a.a.
	9	Sandstone	a.a.
	1	Pyrite	Cementing quartz grains.
	Trace		Limonite, red a.a.

DEPTH (m)	%	CONSTITUENTS	DESCRIPTION
427½-430	95	Sand	a.a., ranging to pebble size.
	4	Sandstone	a.a., except includes well sorted siltstone.
	1	Pyrite	
	Trace		Yellow limonite; shale.
N.B. Strong odour of hydrogen sulphide under microscope lamp.			
430-430½	70	Shale	Dark grey to grey brown, swells in water, calcareous, slightly micaceous and silty.
	20	Sand	a.a.
	10	Pyrite	Cementing quartz grains.
N.B. At 430.59 (samples collected from drill bit)			Shale, dark grey to grey-brown, finely silty with tiny carbonaceous flecks, glauconite, and trace amounts of mica.
N.B. Strong odour of hydrogen sulphide under microscope lamp.			
430.59 - 433.59		Core 1	Recovered 1.35 m. See Appendix III.
434-435	60	Shale	Dark grey, hard, slightly silty, carbonaceous, pyritic.
	40	Quartzite	White, pale blue (dominant) blue-green; mainly clear quartz, very minor dark grains; dominantly well sorted, fine grained (very minor, poorly sorted: fine-medium grained), low to high (mostly high) sphericity, sub-angular-well rounded. Very minor white clay matrix (5%). Very hard, cemented by silica.
435-437½	60	Shale	a.a.
	40	Quartzite	a.a.
437.69 - 438.32		Core 2	Recovered 43 cm. See Appendix III.
438.32 - 439.48		Core 3	Recovered 38 cm. See Appendix III.
439.48		TOTAL DEPTH	

A P P E N D I X I I I

CORE DESCRIPTIONS

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CORE DESCRIPTION

WELL OODNADATTA TOWN BORE 2
LOCATION BESIDE OODNADATTA WATER TOWER
LAT. 27° 32' 35"
LONG. 135° 27' 05"
ELEVATION GR. 120·8 m DATUM GR.
R.T. 121·8 m

CORE NO. FISHING CORE.
DEPTH Approx. 72m.
DATE DRILLED (?) 10 MAY 1974.
RECOVERY 2·0·5 cm. 100. %
FORMATION OODNADATTA FORMATION

DEPTH (METRES)	GRAPHIC LOG	DRILL TIME MINS	RECOVERY LOG	DESCRIPTION
0·0				Sandstone: olive green, consisting dominatly of quartz and glauconite in ratio 80:20 (minor 60:40). Quartz grains are clear, with trace amounts of orange, and mainly very fine grained, with minor coarse silt and very minor fine grained. Grains are angular - rounded, low - mainly high sphericity. Glauconite grains are dark green and slightly coarser grained than quartz, subrounded - rounded medium - high sphericity. Up to 1% small mica flakes. The sandstone is friable - with a soft (when wet) clay matrix (comprising about 10% of rock). There are minor grey shale blebs and siltstone lenses, 0·5 - 2mm long. These partly show the bedding, which is otherwise indeterminate - There are a few impressions of organic material on the bedding plane.
0·1				
0·2				

CORE BARREL
CORE BIT 6" DIAM.
TIME—START
FINISH

LOGGED BY
R.C.N. THORNTON
DATE 28TH AUG

PETROLEUM GEOLOGY SECTION

SHEET 1 OF 1

DRG. NO. S11033 Bd

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CORE DESCRIPTION

WELL OODNADATTA TOWN BORE 2
LOCATION BESIDE OONADATTA WATER TOWN
LAT. 27° 32′ 35″
LONG. 135° 27′ 05″
ELEVATION GR. 120·8 m DATUM GR
R.T. 121·8 m

CORE NO. 1
DEPTH 430·59 – 433·59 m
DATE DRILLED 1 MAY 1974
RECOVERY 1·35 m 45 %
FORMATION ALGEBUCKINA SANDSTONE

DEPTH (METRES)	GRAPHIC LOG	DRILL TIME MINS	RECOVERY LOG	DESCRIPTION
430·5				Pyritic Sandstone : clear (v.minor blue) quartz, angular-rounded, low-high sphericity, poorly sorted - fine to very coarse grained, but mostly f-m.gr. plus very minor (1%) pyritised shale fragments cemented by pyrite, showing large cubic crystals; very hard.
0·6				
0·7				Interbedded Shale & Sandstone (60:40) – shale dark grey with minor amounts of mica & fine quartz silt disseminated throughout. Sandstone - clear quartz, well sorted, f.gr.; ang.-subr., med-high sph., plus mica, both muscovite & biotite (the latter in part chloritised) disseminated throughout in varying proportions from 0 to 10%. Mica also occurs frequently as very thin bands across the core. Sandstone is also slightly carbonaceous. Shale & sandstone interbeds vary in thickness, up to 2cm. for sandstone, 5cm. for shale, lensing in & out. Sandstone fairly well cemented by white (kaolinitic ?) matrix (comprising 5-10% of the rock) Occassional med.-coarse qtz. grains occur in both sandstone & shale
0·8				
0·9				
431·0				
0·1				
0·2				
0·3				
0·4				Interbedded Shale & Sandstone (80:20). As above, except qtz. grains are very fine grained predom-inantly. Small patches occur where shale contains about 50% qtz & mica (as above) Thin (up to 2cm. mostly 0·5cm.) very lensy sandstone interbeds, slight indications of load structures of sand on shale. Sandstone rather less micaceous than above & micaceous bands are infrequent.
431·5				
0·6				
0·7				
0·8				
0·9				Interbedded Shale & Sandstone as between 430·61 – 430·87
432·0				Sandstone, clear quartz, with a very few white grains, very poorly sorted silt to granule, mostly f-m.gr., angular to rounded, low to high sphericity, abundant biotite and muscovite (5-10%) white ? kaolinite matrix (5%)
				Dip : Horizontal overall

CORE BARREL 10' MINDRILL STATION- LOGGED BY
CORE BIT MINDRILL ARY INNER TUBE R.C.N. THORNTON
TIME–START 1430 HRS. DATE 2 MAY 1974
FINISH 1730 HRS

PETROLEUM GEOLOGY SECTION

SHEET 1 OF 1 DRG. NO. S 11032 Bd

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CORE DESCRIPTION

WELL *OODNADATTA TOWN BORE 2*
LOCATION *BESIDE OODNADATTA WATER TOWER*
LAT. *27° 32' 35"*
LONG. *135° 27' 05"*
ELEVATION GR. *120·8 m* DATUM *G.R.*
R.T. *121·8 m*

CORE NO'S *2 & 3*
DEPTH *437·69 – 438·32 – 439·48*
DATE DRILLED *23RD & 24TH MAY 1974*
RECOVERY *(2) 43cm (3) 38cm (2) 66% (3) 33%*
FORMATION *(?) ORDOVICIAN*

DEPTH (METRES)	GRAPHIC LOG	RECOVERY LOG	DESCRIPTION
437·69			
7			
8			
9			
438·0			
1		NO RECOVERY	
2			
3			
438·32			
4			
5			
6			
7			
8		NO RECOVERY	
9			
439			
1			
2			
3			
4			
439·48		439·48	

CORE No 2 — CORE No 2

CORE No 3 — CORE No 3

QUARTZITE: pale grey to off-white orthoquartzite made up almost entirely of very fine grained quartz sand with suspected siliceous cement. Bedding in the quartzite is made obvious by the dark grey shale bands. Thick shale bands in this section are rare, the thickest being approx. 1cm. with the majority being less than 1mm. These show that the quartzite is dipping at approx. 45° to 50° as the bedding is gently undulating. Occassional mica flakes and numerous fine flecks of (?) kaolin occur in the quartzite.

The shale appears to contain very small bedding oriented mica flakes with occassional larger flakes. The remainder of the shale material is too fine to identify. Rare laminae of honey quartz occur in some of the shale partings

CORE BARREL *10' MINDRILL STATIONARY INNER TUBE*
CORE BIT *MINDRILL*
TIME–START *11:00* (2) *10:00* (3)
FINISH *13:00* (2) *13:00* (3)

LOGGED BY *I. J. TOWNSEND*
DATE *26TH MAY 1974*

PETROLEUM GEOLOGY SECTION

SHEET *1* OF *1*
DRG. NO. S11031 Bd

A P P E N D I X I V

PETROGRAPHIC DESCRIPTIONS

by

R.S. Cooper
Australian Mineral Development Laboratories

Report MP4230/74

PETROGRAPHIC DESCRIPTION OF SEVEN SAMPLES FROM OODNADATTA TOWN BORE 2

1. INTRODUCTION

Seven samples of rotary borehole chippings from various depths in the Oodnadatta Town Bore 2 were submitted by the S.A. Department of Mines (R.C.N. Thornton - Petroleum Geology Section) for petrographic description. It was also requested that photomicrographs be taken of Sample PG73 and any other samples with interesting structures.

2. SUMMARY

Details of the samples described are as follows:-

Sample Number	Thin Section Number	Depth in borehole	Rockname
PG68, P107/74	32334	132.5-135 m	Weathered/altered glauconitic sandstone.
PG69, P108/74	32335	200-217.5 m	Carbonate rock.
PG70, P109/74	32336	320-322.5 m	Glauconitic siltstone and glauconitic silty sandstone.
PG71, P110/74	32337	389 m	Fine granular carbonate.
PG72, P111/74	32338	395-397.5 m	Calcareous sandstone.
PG 73, P112/74	32339	412-415 m	Calcareous oolitic sandstone.
PG74, P113/74	32340	434-435 m	Quartzite.

3. PETROGRAPHIC DESCRIPTIONS

Sample: PG68, P107/74; TS: 32334

Location:
Oodnadatta Town Bore 2, 132.5 to 135 m.

Rock Name:
Weathered/altered glauconitic sandstone.

Hand Specimen:
This sample of chippings consists of a brown, friable, fine grained rock.

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

	%	XRD Analysis results %
Clay (montmorillonite)	35-45	D
Carbonate (?calcian siderite)	10-20	A
Feldspar	?<5	A
Kaolin/chlorite	?<10	A
Iron oxides/hydroxides	?<5	n.d.

These chippings have a clastic sedimentary texture, an even grain size typically between 0.05 and 0.1 mm, and are composed principally of weathered/oxidised glauconite pellets, with lesser amounts of quartz, and minor amounts of carbonate and several other minerals.

The glauconite pellets are mostly oval in shape, up to 0.3 mm across, and crudely aligned with the bedding. In chips with a predominantly carbonate matrix they are green to green brown in colour whereas in rocks with a quartz/clay matrix they are brown and oxidised in appearance. No glauconite was detected in the x-ray diffraction analysis of this sample and the largely altered pellets probably consist of clay (kaolin/chlorite) and amorphous iron oxides/hydroxides. Where it is green and fresher looking the galuconite is possibly not sufficiently well crystallised to be recorded on the x-ray diffractometer trace.

Quartz and feldspar occur as sub-angular to rounded grains of even size, typically in the range 0.03 mm to 0.1 mm. The proportion of feldspar present is uncertain because of the difficulty of distinguishing untwinned feldspar from quartz in such fine material.

The proportion of carbonate varies considerably, with some chips containing none and others containing over 50%. The carbonate is finely granular, almost micritic, and where present in major amounts forms the matrix to the glauconite pellets and the quartz and feldspar grains. The x-ray diffraction pattern of this mineral suggests it has an unusual composition, and possibly it is a calcian siderite.

The clay in this sample (montmorillonite) occurs interstitially, and in patches of similar size and shape to the quartz and feldspar grains and the glauconite pellets.

This sample is a weathered/oxidised glauconitic sandstone.

Sample: PG69, P108/74; TS: 32335

Location:
Oodnadatta Town Bore 2, 200 to 217.5 m.

Rock Name:
Carbonate Rock.

Hand Specimen:
These chips are off-white, grey, and brown coloured, fine grained, and up to 5 mm across.

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

	%
Calcite	35-45
?Dolomite	10-20
Unidentified carbonate	40-50
Quartz	2-4
Opaques	1-2

The unidentified carbonate which predominates in this sample is a pale brown colour and finely granular, with a grain size between 0.02 and 0.06 mm. Dispersed through this carbonate are a few similarly sized grains of quartz and opaques. It is irregularly veined by another carbonate which is clearer and contains crystals up to 0.1 mm across.

Calcite was distinguished from the other carbonates by a micro-chemical test and it occurs separate from the other carbonates or at least in chips that do not contain them.

Crystals of calcite are up to 0.3 mm long and characteristically have a bladed habit which suggests they have formed in veins.

This sample of rotary borehole chips consists essentially of several carbonate minerals of which an unidentified one, possibly the calcian siderite identified by x-ray diffraction in sample P107/74, appears to predominate.

There are trace amounts of fine grained and microspherular pyrite.

Sample: PG70, P109/74; TS: 32336

Location:
Oodnadatta Town Bore 2, 320 to 322.5 m.

Rock Name:
Glauconitic siltstone and glauconitic silty sandstone.

Hand Specimen:
The chippings in sample are pale brown, fine grained and up to 4 mm across.

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

	%	XRD Analysis results %
Clay (montmorillonite	70-80	D
kaolin/chlorite		A
Quartz	10-20	A-SD
Muscovite	2-4	A
Feldspar	2-4	A
Iron oxide/hydroxides	2-4	N.D.

These chips have a clastic sedimentary texture, a variable grain size and consist principally of clay, glauconite pellets, and quartz.

The glauconite pellets are green to yellow brown in colour, oval in shape, aligned with the bedding, and up to 0.3 mm long. Glauconite was not recorded on the x-ray diffractometer trace of this sample which means that the mineral is either not truly crystallised or that it is altered/oxidised, probably in this case to kaolin/chlorite and iron oxide/hydroxides. This glauconite does however appear fresher than that in sample P107/74.

Quartz and feldspar occur as sub-angular grains up to 0.2 mm across. These are aligned parallel to the bedding in the rock and the feldspar appears to be sodic plagioclase.

The proportion of clay to quartz and glauconite pellets varies in the different chips. In the sandstone fragments even though most of the clay is interstitial there are some patches, up to 0.3 mm across, which suggest that some of the clay was deposited as flakes or pellets. In one of the siltstone chips there is a network of vein like structures, filled with clay and iron oxides/hydroxides, which are possibly infilled shrinkage cracks.

A small amount of muscovite/sericite occurs admixed with the clay and there are a few opaque veins up to 0.2 mm across. This sample consists of a clayey sedimentary rock which contains pellets of glauconite. Compared to sample PG68, P107/74, it is finer grained, the glauconite appears fresher, and there is no carbonate.

Sample: PG71, P110/74; TS: 32337

Location:
Oodnadatta Town Bore 2, 389 m.

Rock Name:
Fine granular carbonate.

Hand Specimen:
This sample consists of fine grained, pale brown chips.

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

	%
Carbonate	>95
Quartz	trace

This sample consists essentially of finely granular, almost micritic carbonate. It is largely textureless except for some irregularly shaped areas, up to several mm across, where it is clearer, slightly coarser grained, and evidently recrystallised. A few quartz grains, up to 0.08 mm across are present dispersed through the carbonate. The identity of this carbonate is uncertain as it did not respond to a microchemical test for calcite. It is possibly the calcian siderite which was identified by x-ray diffraction techniques in sample PG68, P107/74.

Sample: PG72, P111/74; TS: 32338

Location:
Oodnadatta Town Bore 2, 395 to 397.5 m.

Rock Name:
Calcareous sandstone (described by client as Cadna-owie Siltstone).

Hand Specimen:
This sample consists of a number of pale brown, fine grained chips up to 5 mm across.

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

	%
Quartz	20-30
Feldspar	3-6
Carbonate	65-75
?Glauconite	trace-2
Muscovite	trace-2
Opaques (some pyrite)	trace-2

This sample has a clastic sedimentary texture, and consists essentially of grains of quartz, with minor feldspar, in a matrix of carbonate.

The carbonate is brown, semi-opaque in parts, and finely granular, with a grain size of 0.03 mm or less.

Quartz grains are poorly sorted, ranging in size from 0.03 mm to 0.2 mm, and are mostly sub-angular in shape. It is possible that their angularity results from partial replacement by the carbonate matrix. Feldspar grains are of similar size and shape as those of quartz, and appear to consist mainly of sodic plagioclase.

A few equant but irregularly shaped patches of green to green brown ?glauconite, which are up to 0.2 mm across, as well as a few opaque grains, up to 0.1 mm across, are present in this sample.

Muscovite flakes, up to 0.3 mm long, are present, and it is noticeable that similar to quartz, they show no preferred orientation to bedding.

This sample is a poorly sorted, immature calcareous sandstone.

Sample: PG73, P112/74; TS: 32339

Location:
Oodnadatta Town Bore 2, 412.5 to 415 m .

Rock Name:
Calcareous oolitic sandstone.

Hand Specimen:
These chips consist of a green, brown friable sandstone.

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

	%
Quartz	30-40
Feldspar	2-4
Carbonate	25-35
Oolites (?chamosite)	10-20
Clay	10-20
Iron oxides/hydroxides	2-4

This sample consists of grains of quartz and feldspar, and oolites of ?chamosite, in a matrix of carbonate and less commonly clay. The grain size is quite coarse with both oolites and quartz grains up to 1 mm across.

The quartz grains are sub-angular to well rounded in shape, and up to 1 mm across. Even the largest grains consist of single crystals, no polycrystalline aggregates, i.e. quartzite, being present. Feldspar grains are of similar shape to those of quartz but the largest are only about 0.3 mm across. Both plagioclase and microcline are present, the latter being recognised by its cross-hatch twinning.

The oolites are green brown, concentrically zoned, often have a nucleus consisting of either a quartz or a feldspar grain, and are up to 1 mm long. Alteration has resulted in some of the oolites being leached away and others being partially replaced with iron oxides/hydroxides.

The carbonate matrix is a pale brown colour and granular, containing crystals up to 0.15 mm across. In a few chips the matrix consists of pale brown, isotropic clay.

This sample very closely resembles rocks described by Williams, Turner, and Gilbert (1953, Page 368), and it is most likely that the oolites consist of chamosite and the matrix carbonate is siderite.

Sample: PG74, P113/74; TS: 32340

Location:
Oodnadatta Town Bore 2, 434 to 435 m.

Rock Name:
Quartzite.

Hand Specimen:
This sample consists of pale brown quartzose chips with a grain size of less than 0.5 mm.

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

	%
Quartz	>95
Plagioclase	1-2
Microcline	1-2
Phyllosilicates	trace
Accessories; apatite	trace

This sample has a granular texture, a regular and even grain size of 0.15 mm, and consists essentially of quartz.

The quartz occurs as equant, interlocked, sub-idiomorphic to polygonal grains. Also present are grains of chalcedony of similar size, (0.15 mm) to the grains of quartz. Small amounts of sericite and opaques are associated with some of this micro-crystalline quartz and it is believed that these grains are re-crystallised/indurated lithic/siltstone detritus.

A few grains of feldspar both plagioclase and microcline, are present, and one grain of apatite was seen.

Most of the detrital grains are surrounded by optically continuous overgrowths and these have intergrown to fill inter-stices. There is no evidence of recrystallisation.

This sample consists of chips of quartzite, derived through the induration of a relatively pure sandstone composed of well sorted grains.

4. REFERENCES

Williams, H., Turner, F., and Gilbert, C., 1954 Petrography. W.H. Freeman and Co., San Francisco.

DESCRIPTION OF PHOTOMICROGRAPHS

The photomicrographs were taken with a x 1 Leitz lens and the magnification of the prints is x 14. This means that the field of view of the prints is 5 mm by 6.5 mm.

(a) PG73, P112/74, TS 32339. Oolites of chamosite occur seated in a matrix consisting largely of quartz grains (clear) and ? siderite (grey/speckled).

(b) PG70, P109/74, TS 32336. A chip, consisting of finely divided quartz (clear) and clay, which appears to contain shrinkage cracks. These consist of clay and iron oxides/hydroxides. The darker patches (top centre) are altered pellets of glauconite.

(c) PG69, P108/74, TS 32335. The lower chip consists of calcite with a bladed habit that suggests it may have formed in a vein. The upper chip consists of dark fine-grained turbid carbonate and veins of clear slightly coarser-grained carbonate.

(d) PG70, P109/74, TS 32336. This chip consists of clay (light grey), grains of quartz (clear), and glauconite pellets (dark grey).

N.B. For a clearer photograph of these photomicrographs, please refer to the original AMDEL report.

a.

b.

PLATE 1

c.

d.

A P P E N D I X V

PALAEONTOLOGICAL REPORT

by

W.K. Harris and J.M. Lindsay

Biostratigraphy Division

DEPARTMENT OF MINES
SOUTH AUSTRALIA

MICROPALAEONTOLOGY OF CORES FROM OODNADATTA TOWN BORE NO. 2

By

W.K. Harris & J.M. Lindsay

Biostratigraphy Division

8th November, 1974

Rept.Bk.No. 74/212
G.S. No. 5526
Biostrat No. 9/74
D.M. No. 1124/72

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 74/121
G.S. No. 5526
Biostrat.No.9/74
D.M. No. 1124/72

MICROPALAEONTOLOGY OF CORES FROM OODNADATTA TOWN BORE NO. 2

ABSTRACT

Two cores from Oodnadatta Town Bore No. 2 were examined for microfossils. A fishing core at about 72 m is of Late Albian to ?Cenomanian age and is correlated with the Mt. Alexander Sandstone Member of the Oodnadatta Formation in Santos Oodnadatta No. 1 Well. It is of marginal marine aspect.

Core 1 at 431.4 m is non-marine and earliest Cretaceous in age. If the rock unit is to be equated with the Algebuckina Sandstone, then an upwards extension of the age of the formation is indicated.

INTRODUCTION

This report details micropalaeontological examination (foraminifera and palynomorphs) of cores from Oodnadatta Town Bore No. 2. The locality and lithological succession of the bore are detailed in RB 74/178 by R.C.N.Thornton.

A"fishing core" at approximately 72 m and Core 1 at 431.4 m have yielded microfossils. Palynological preparations of Cores 2 & 3 were barren of microfossils and no evidence as to age is forthcoming.

RESULTS

Fishing Core at approximately 72 m

A greenish grey, silty, very fine grained sandstone and minor silty shale; not calcareous; abundant glauconite.

Only two foraminifera found:

Haplophragmoides lapillosus Ludbrook - one specimen; and one poorly preserved specimen tentatively identified as *Ammobaculites minimus* Crespin.

Some glauconite grains clearly represent internal casts of foraminifera

indicating leaching of calcareous tests.

Plant fragments are abundant and include the megaspores:

Arcellites reticulatus (Dijkstra) - common

A. hexapartitus (Cookson & Dettmann) - rare

A. nudus (Cookson & Dettmann) - very rare

iridescent megaspore fragments - rare

and several species of *Minerisporites*.

Palynological residues of this core (Sample No. S3079) yielded:

SPORES & POLLEN

Aequitriradites verrucosus (Cookson & Dettmann)

A. spinulosus (Cookson & Dettmann)

Appendicisporites aff. A. distocarinatus Dettmann & Playford

Balmeisporites holodictyus Cookson & Dettmann

Cicatricosisporites australiensis (Cookson)

C. ludbrooki Dettmann

Clavatipollenites sp.

Contignisporites glebulentus Dettmann

Coptospora paradoxa (Cookson & Dettmann)

Cyclosporites hughesii (Cookson & Dettmann)

Perotriletes jubatus (Dettmann & Playford)

Phimopollenites pannosus (Dettmann & Playford)

Schizosporis reticulatus Cookson & Dettmann

DINOFLAGELLATES & ACRITARCHS

Apteodinium sp.

Canningopsis denticulata Cookson & Eisenack

Coronifera oceanica Cookson & Eisenack

Cribroperidinium muderongensis (Cookson & Eisenack)

Cyclonephelium distinctum Deflandre & Cookson

Diconodinium glabrum Eisenack & Cookson

D. multispinum (Deflandre & Cookson)

D. cf. *D. pelliferum* (Cookson & Eisenack)

Endoceratium ludbrooki (Cookson & Eisenack)

Exochosphaeridium phragmites Davey *et al.*

Odontochitina operculata (O.Wetzel)

? *Psaligonyaulax* sp.

Spiniferites ramosus (Ehrenberg)

Tenua sp.

Palynomorphs from this core were abundant and accompanied by much lignified tissue and cuticle.

Core 1 at 431.4 m - palynological sample No. 53038

Only palynomorphs were recovered from this core and these are restricted to terrestrial forms. They are accompanied by abundant woody material.

SPORES & POLLEN include:

Aequitriradites hispidus Dettmann & Playford

A. spinulosus (Cookson & Dettmann)

A. verrucosus (Cookson & Dettmann)

Alisporites grandis (Cookson)

Baculatisporites comaumensis (Cookson)

Ceratosporites equalis Cookson & Dettmann

Cicatricosisporties australiensis (Cookson)

C. cf. *C. ludbrooki* Dettmann

Classopollis sp.

Contignisporites cooksonii (Balme)

Cooksonites variabilis Pocock

Cyathidites asper (Bolkovitina)

C. australis Couper

C. minor Couper

Dictyotosporites complex Cookson & Dettmann

Foraminisporis asymmetricus (Cookson & Dettmann)

Ischyosporites punctatus Cookson & Dettmann

cf. *Laevigatosporites major* (Cookson)

Lycopodiumsporites austroclavatidites (Cookson)

L. circolumenus Cookson & Dettmann

Matonisporites cooksonii Dettmann

Microcachyridities antarcticus Cookson

Minerisporites sp.

Murospora florida (Balme)

Osmundacidites wellmanii Couper

Podocarpidites ellipticus (Cookson)

Podosporites microsaccatus (Couper)

Sestrosporites pseudoalveolatus (Couper)

Stereisporites antiquasporites (Wilson & Webster)

Tsugaepollenites dampieri (Balme)

DISCUSSION & CONCLUSIONS

Fishing Core

The presence of the foraminifer *H. lapillosus* indicates a correlation with sediments above 103.6 m in Santos Oodnadatta No. 1 Well. These are of Albian - ?Cenomanian age according to Ludbrook (1966).

The presence of the palynomorphs *P. pannosus, C. paradoxa* and *P. jubatus* identify the assemblage as *P. pannosus* zone of Dettmann & Playford 1969. They record the zone between 26.52 and 50.90 m in the Mt. Alexander Sandstone Member of the Oodnadatta Formation. Dettmann & Playford (*op. cit.*) do not elaborate on Ludbrook's assignment of an Albian - ?Cenomanian age.

The presence of the dinoflagellate *O. operculata* and the absence of *Ascodinium parvum* indicates a correlation with *O. operculata* zone of Evans (1966). This core then falls within the uppermost section of the *O. operculata*

zone and the lower half of the *P. pannosus* zone (see Table 9:4, Dettmann & Playford, 1969) and therefore correlates with part of the Mt. Alexander Sandstone Member.

The abundance of well preserved spores, pollen and marine dinoflagellates with associated carbonaceous matter, points to a nearshore marine environment with acid pH and reducing conditions. Lowered salinities from freshwater run-off are indicated by the abundance of plant debris and especially megaspores. These latter factors would be responsible for dissolution of carbonate minerals.

The predominance of plant remains, including megaspores, indicates similar brackish, marginal-marine facies to that above 67.1 m (220 ft) in the Santos Oodnadatta No. 1 Well.

This sandstone core at approximately 72 m should thus be correlated with the Mt. Alexander Sandstone Member of Oodnadatta Formation, rather than the Coorikiana Member.

Core 1

The assemblage from Core 1 is entirely non-marine and the presence of *A. hispidus*, *D. complex* and *M. florida* identify the assemblage as belonging to the *Crybelosporites stylosus* zone of Dettmann & Playford (1969). These authors have discussed the age of the zone and conclude that the lower age limit may be within the Late Jurassic. However, the assemblage recorded here contains in particular *C. variabilis* which appears later in the zone and two species of *Aequitriradites*, *A. spinulosus* and *A. verrucosus* which are not known to occur below the Valanginian of Russia and Canada (Dettmann, 1963). Furthermore Dettmann (1963) does not record these species in the lowest horizons of her late Mesozoic sequence.

The age of this core then is best regarded as Neocomian.

If the rock type is to be correlated with the Algebuckina Sandstone, then this represents an extension of age into the earliest Cretaceous for the Formation. Previous evidence (Harris, 1970, 1972) has indicated a late Jurassic age elsewhere for the unit.

The alternative correlation is with the Cadna-owie Formation. Palynological evidence at the type section of this unit (Harris & McGowran, 1973 p.74) indicates a correlation with the *Dictyotosporites speciosus* zone and it is therefore younger than the core reported on here.

8th November, 1974

W.K. HARRIS
PALYNOLOGIST

J.M. LINDSAY
PALAEONTOLOGIST

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A P P E N D I X V I

PUMP TEST REPORT

by

D.K. Lock
Engineer
Drilling & Mechanical Branch

Oodnadatta Town Bore 2 - Development by Pumping

The No. 2 well at Oodnadatta has been pumped with a 3" Sykes pump in an attempt to clear sand from the aquifer and increase the flow.

The period of pumping was from 1/7/74 to 4/7/74.

1/7/74:		Artesian flow 3.25 l/sec. Shut in pressure 34.45 k Pa.
	1.30 p.m.	Commenced pumping at 7.5 l/sec, fine sand produced after 1.45 p.m.
	3.00 p.m.	7.5 l/sec sand being produced.
	5.00 p.m.	8.1 l/sec sand being produced.
	8.00 p.m.	No sand being produced - pump shut down.
2/7/74:	7.30 a.m.	Pump re-started - 7.5 l/sec no sand produced.
	8.00 a.m.	5.9 l/sec - no sand
	9.00 a.m.	4.0 l/sec - " "
	10.00 a.m.	3.5 l/sec - " "
	11.00 a.m.	Pump shut down. Artesian flow 3.25 l/sec, shut in pressure 17.23 k Pa.
3/7/74:	2.30 p.m.	Pumping recommenced after suction disconnected from well head and connected to tail pipe inside casing.
	3.00 p.m.	Pumping rate 9 l/sec - large amounts of sand produced, very fine. Drawdown inside casing 3.66 m.
	5.00 p.m.	8.75 l/sec - sand decreasing.
	8.00 p.m.	8.75 l/sec - no sand. Pump shut down, artesian flow rate 3 l/sec.
4/7/74:	7.00 a.m.	Artesian flow rate 3.25 l/sec.
	7.30 a.m.	Commenced pumping 9 l/sec.
	9.00 a.m.	Pump motor r.p.m. increased to maximum - pumping rate 10 l/sec.
	10.00 a.m.	10 l/sec - no sand.
	11.00 a.m.	10 l/sec - drawdown 3.73 m.
	12.00 noon	10 l/sec - no sand.
	3.00 p.m.	10 l/sec - " "
	5.00 p.m.	10 l/sec - " ". Pump shut down.

5/7/74:	7.30 a.m.	Artesian flow 3.4 l/sec.
	5.00 p.m.	Artesian flow 3.4 l/sec, well shut down - head pressure 34.45 k Pa.

Water samples taken:

1/7/74	-	1.30 p.m.	
	-	5.00 p.m.	
3/7/74	-	8.00 p.m.	
5/7/74	-	5.00 p.m.	FINAL

A P P E N D I X V I I

WATER ANALYSES

by

S.A. Department of Mines

and

Australian Mineral Development Laboratories

AMDEL

WATER ANALYSIS

Sample No. W3497/74

CHEMICAL COMPOSITION

	Milligrams per litre	Millequivs. per litre
CATIONS	mg/l	me/l
Calcium	67.0	3.3
Magnesium	28.0	2.3
Sodium	548.0	23.8
Potassium	19.0	0.5
ANIONS		
Hydroxide	0	0
Carbonate	0	0
Bicarbonate	275.0	4.5
Sulphate	314.0	6.5
Chloride	680.0	19.2
Nitrate	<1	0

TOTALS & BALANCE

CATIONS (me/l) 30.0 DIFF. = 0.2

ANIONS (me/l) 30.2 SUM =60.2

$\frac{\text{DIFF} \times 100}{\text{SUM}} = 0.4\%$

DERIVED AND OTHER DATA

Conductivity (E.C.): Micro-S/cm at 25°C = 3029

	Milligrams per litre Mg/l
TOTAL DISSOLVED SALTS Calculated (HCO3 = CO3)	1790.0
Total hardness as CaCO3	283.0
Carbonate hardness as CaCO3	225.0
Non-carbonate hardness as CaCO3	57.0
Total alkalinity as CaCO3	225.0

Reaction - pH = 7.1

Sodium to total cation ratio (Me/l) = 79.5%

YARDINNA 1

OODNADATTA 1

OODNADATTA TOWN BORE 1 AND 2

ELEVATION IN METRES

150
100
50
0
−50
−100
−150
−200
−250
−300
−350

VERTICAL EXAGGERATION=62.5×

Q—R

? MT. ALEXANDER

WOOLDRIDGE LIMESTONE MEMBER

COORIKIANA

SANDSTONE MEMBER ?

OODNADATTA FORMATION

?

?

SANDSTONE MEMBER

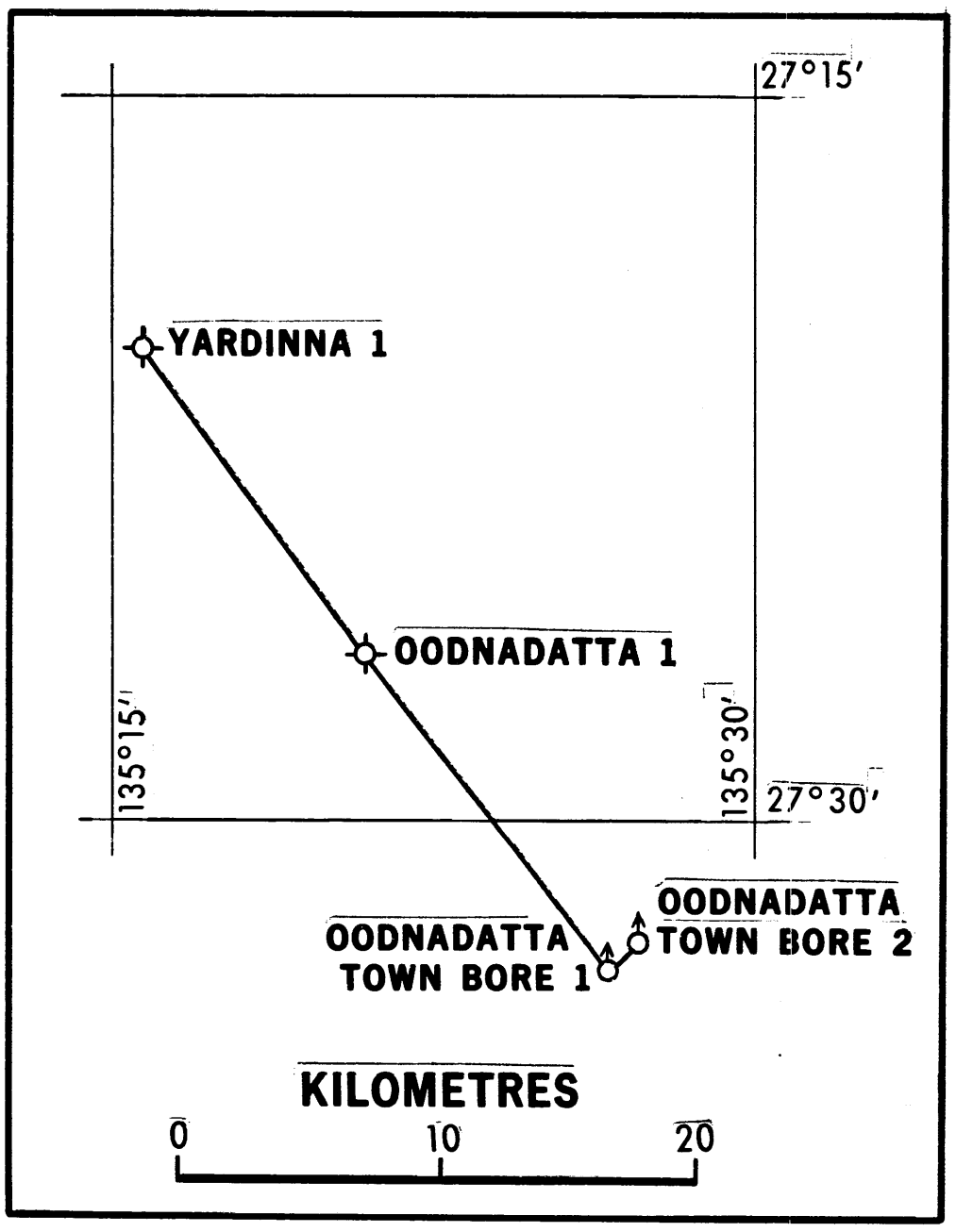
BULLDOG SHALE

CADNA—OWIE FORMATION

ALGEBUCKINA SANDSTONE

(?) ORDOVICIAN QUARTZITE

LOCALITY MAP



LEGEND

Carbonate

Clay/Shale

Siltstone

Sandstone

Pebbles

Ooids

Quartzite

74—895 MRR 141

R. Thornton, Geologist

S.A. Department of Mines

DEPTH IN METRES

0
50
100
150
200
250
300
350
400

Drilling with 5 1/8" bit

Waiting for drill bits

Core 1

Logging well

Reaming with 8 bit

Dropped 5 1/8" pilot bit

Fishing

Reaming with 8 bit

Reaming and drilling with 5 bit

Core 3

Core 2

Reaming with 8 bit

Logging well

Running casing

Drilling out cement plug and cleaning hole

Fitting well head

9 10 15 20 25 30 1 5 10 15 20 25 30 31 1 5

APRIL — MAY — JUNE

74—894 MRR141

R.Thornton Geologist

S.A. Department of Mines

COMPOSITE WELL LOG

SOUTH AUSTRALIAN DEPARTMENT OF MINES

OODNADATTA TOWN BORE 2

STATE : SOUTH AUSTRALIA PETROLEUM TENEMENT: P.E.L. 5/6 1:250000 MILE SHEET: OODNADATTA BASIN: GREAT ARTESIAN

WELL STATUS: WATER BORE

LOCATION: 27° 32' 35" S 135° 27' 05" E

ELEVATION: GR 120.8 m KT: 121.8 m

DATE SPUDDED: 5TH APRIL 1934

DATE DRILLING COMPLETED: 31ST MAY 1934

DATE RIG RELEASED: 5TH JUNE 1934

TOTAL DEPTH: 439.48m

HOLE SIZE:

INCHES	FROM (m)	TO (m)
11¾	0	5.35
9¾	5.35	455.90
Reamed 8	5.35	415.71
5⅞	455.30	437.67
3.907	437.67	439.48

CASING:

INCHES	DEPTH (m)	CEMENTED TO	FROM (m)
6	415.71	Surface	410

CEMENT PLUGS: None

TYPE OF LOG	18. IN. NORMAL	64. IN. NORMAL	6 FT. LATERAL	S.P.	NEUTRON (Tonti)	NEUTRON (Mata)	GAMMA RAY
DATE OF RUN	4-5-34	4-5-34	4-5-34	4-5-34	4-5-34	29-5-34	29-5-34
FIRST READING	434	432	434	435	435	439	439
LAST READING	25	25	16	14	14	7	6
INTERVAL MEASURED	409	407	418	421	421	432	433
CASING: LOGGER	–	–	–	–	–	414	–
CASING: DRILLER	415.72	415.72	415.72	415.72	415.72	415.72	415.72
DEPTH REACHED	434	434	434	435	435	439	439
BOTTOM: DRILLER	439.48	439.48	439.48	439.48	439.48	439.48	439.48
MUD TYPE	water brine	water brine	water brine	water brine	water brine	water brine	water brine
DENSITY/ VISCOSITY							
Ph/ FLUID LOSS cc							
MUD RESISTIVITY	146 ohm-m at 19°C						
RECORDED BY	C.R. WEST	C.R. WEST	C.R. WEST	C.R. WEST	C.R. WEST	C.R. WEST	C.R. WEST
WITNESSED BY	R.C.N.T.	R.C.N.T.	R.C.N.T.	R.C.N.T.	R.C.N.T.	I.J.T.	I.J.T.

NB. LOGS RUN FROM GROUND LEVEL

OTHER SURVEYS:

TYPE	FROM	TO
POINT RESISTIVITY	14	435
TEMPERATURE	0	435

DRILLED BY: S.A. DEPARTMENT OF MINES.

DRILLING METHOD: ROTARY.

LOGGED BY: S.A. DEPARTMENT OF MINES.

LITHOLOGICAL REFERENCE

- Shale claystone
- Sandy shale
- Silty shale
- Siltstone
- Argillaceous siltstone
- Sandy siltstone
- Calcite
- Dolomite
- Coal
- Quartzite
- Quartz grains
- Sandstone
- Granular
- Pebble
- Lithic
- Anhydrite (A)
- Pyrite (Py)
- Micaceous (V)
- Carbonaceous (/)
- Ferruginous (Fe)
- Carbonate Fragments (Ca)
- Kaolinitic (K)
- Glauconitic (W)
- Garnet (G)
- Calcareous (L)
- Dolomitic (Z)
- Oolithic (O)
- Fossiliferous Fragmental or Indeterminate (F)
- Feldspathic (f)
- Gypsum Gypsiferous (Gy)
- Manganese (Mn)

WELL SYMBOLS

- CORE INTERVAL AND NUMBER
- PLUGGED INTERVAL
- CASING SHOE
- Fl: FLUORESCENCE
- * CUT WITH CCl_4
- PETROGRAPHY SAMPLE
- PALAEONTOLOGY SAMPLE

LITHOLOGY BY: R.C.N. Thornton & I.J. Townsend

COMPILED BY: R.C.N. Thornton

DRAFTED BY: A. Richardson

DRAWING NUMBER: L.74-14 Sht

DEPARTMENT OF MINES – SOUTH AUSTRALIA

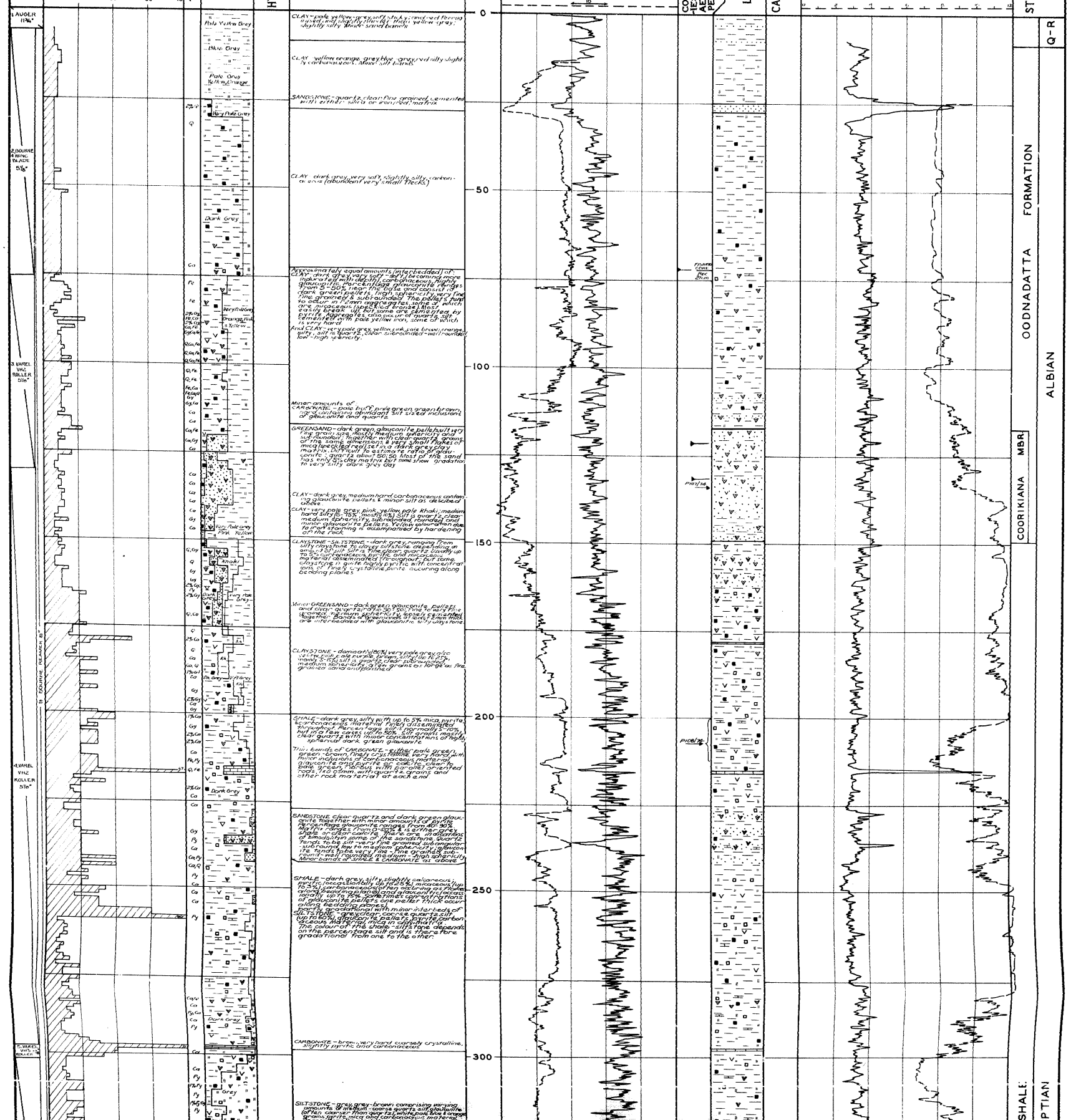
COMPOSITE WELL LOG

OODNADATTA TOWN BORE 2

PETROLEUM SECTION | R.C.N. Thornton GEOLOGIST | DRN. RECD. | SCALE AS SHOWN | L.74-14 | Sht

TCD. A.R. | CHD. A.R. | DATE 6TH OCT. 1934

SEN. GEOLOGIST | E/D



WITNESSED BY	RGNT	RGNT	RGNT	RGNT	RGNT TJT	TJT

NB. LOGS RUN FROM GROUND LEVEL

CEMENT PLUGS: None

OTHER SURVEYS:

TYPE	FROM	TO
POINT RESISTIVITY	16	435
TEMPERATURE	0	435

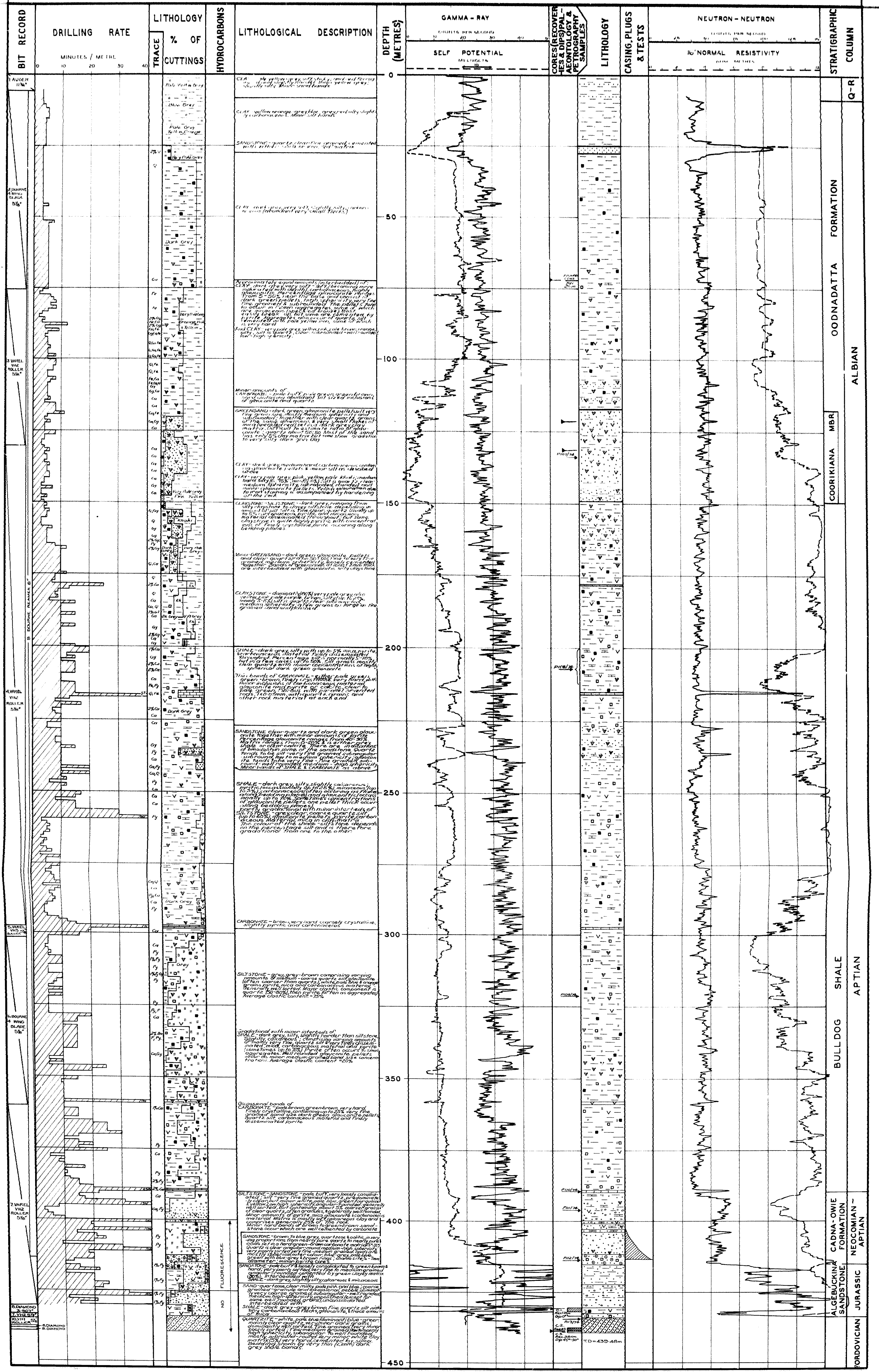
DRILLED BY: S.A. DEPARTMENT OF MINES.
DRILLING METHOD: ROTARY.
LOGGED BY: S.A. DEPARTMENT OF MINES.

Quartzite | Ca Carbonate Fragments | Mn Manganese
Quartz grains

WELL SYMBOLS

CORE INTERVAL AND NUMBER
PLUGGED INTERVAL
CASING SHOE
FI FLUORESCENCE
CUT WITH CCl_4
PETROGRAPHY SAMPLE
PALAEONTOLOGY SAMPLE

LITHOLOGY BY: R.C.N. Thornton & T.J. Townsend
COMPILED BY: R.C.N. Thornton
DRAFTED BY: A. Richardson
DRAWING NUMBER: L.74-64



SELF POTENTIAL	14	435	1:500
POINT RESISTIVITY	14	435	1:500
16" NORMAL RESISTIVITY	25	434	1:500
64" NORMAL RESISTIVITY	25	432	1:500
6' LATERAL RESISTIVITY	16	434	1:500
TEMPERATURE	0	435	1:500

N.B. LOGS RUN FROM GROUND LEVEL

DRILLED BY: S.A. DEPARTMENT OF MINES

DRILLING METHOD: ROTARY

LOGGED BY: S.A. DEPARTMENT OF MINES

Siltstone
Calcite
Quartzite
Q — Quartz grains
Sandstone

Petrography Sample
Palaeontology Sample

Pyrite
V — Micaceous
■ — Carbonaceous
Fe — Ferruginous
Ca — Carbonate Fragments

Calcareous
Oolitic
F — Fossiliferous Fragmental or Indeterminate
Gy — Gypsum Gypsiferous

WELL SYMBOLS

No. 3 — Core interval and number
Casing shoe
Plugged interval
Fl — Fluorescence
* — Cut with CCl_4

LITHOLOGY BY: R. C. N. Thornton and I. J. Townsend.

COMPILED BY: R. C. N. Thornton.

BIT RECORD. | DRILLING RATE MINUTES/METRE (0 10 20 30 40) | TRACE | LITHOLOGY % OF CUTTINGS. | HYDROCARBONS | LITHOLOGICAL DESCRIPTION | DEPTH (METRES) | GAMMA RAY COUNTS PER SECOND (0 10 20 30 40 50); SELF POTENTIAL MINUTES/METRE MILLIVOLTS (10) | CORES (RECOVERIES AND DIPS), PALAEONTOLOGY, PETROGRAPHY SAMPLES. | LITHOLOGY | CASING, PLUGS & TESTS | NEUTRON-NEUTRON COUNTS PER SECOND (0 25 50 75 100 125 150); 16" NORMAL RESISTIVITY. OHM METRES (0 2 4 6 8 10 12) | STRATIGRAPHIC COLUMN.

1 AUGER 11 3/4"

2. BOURNE 4 WING BLADE 5 1/8"

3. VAREL VH2 ROLLER 5 1/8"

4. VAREL VH2 ROLLER 5 1/8"

5. VAREL VH3 ROLLER 5 1/8"

6. BOURNE 4 WING BLADE 5 1/8"

7. VAREL VH2 ROLLER 5 1/8"

8. DIAMOND 3.907" 7 VH2 5 1/8" 10. VH1 ROLLER 5 1/8" 8. DIAMOND 8. DIAMOND

LITHOLOGICAL DESCRIPTION

CLAY, pale yellow-grey, and red ferruginised and slightly silty. Minor sand bands.

CLAY, yellow orange-grey, blue-grey, red silty slightly carbonaceous. Minor silt bands.

SANDSTONE, quartz, clear fine grained, cemented with either silica or iron (red) matrix.

CLAY, dark grey, very soft, sligtly silty, carbonaceous.

Approximately equal amounts (interbedded) of:
CLAY, dark grey, very soft-soft, carbonaceous, highly glauconitic. The pellets tend to occur in 1-2 mm aggregates, some of which are micaceous (speckled bronze) or cemented by pyrite.
And CLAY, very pale grey, yellow, pink, pale brown, orange, silty.

Minor amounts of:
CARBONATE, pale buff, pale green, green brown, hard containing abundant silt sized inclusions of glauconite and quartz.

GREENSAND, dark green, glauconite pellets, silt, very fine grain size, together with clear quartz grains of the same dimensions and very small flakes of mica (speckled red) set in a dark grey clay matrix.

CLAY, dark grey, medium hard, carbonaceous, containing glauconite pellets and minor silt.
CLAY, very pale grey, pink, yellow, medium hard silty (5-15%, mostly 10%)

CLAYSTONE, SILTSTONE, dark grey, ranging from silty claystone to clayey siltstone depending on amount of silt. Silt is fine, clear quartz. Usually up to 5% carbonaceous, pyritic and micaceous material disseminated throughout.

Minor GREENSAND, dark green glauconite pellets and clear quartz (ratio 50:50), fine to very fine grained.

CLAYSTONE, dominantly (80%) very pale grey, also yellow, pink, pale purple, brown, silty (up to 25%, mainly 5-15%), silt is quartz.

SHALE, dark grey, silty with up to 5% mica, pyrite and carbonaceous material finely disseminated throughout. Percentage silt is normally 5-10%.

Thin bands of CARBONATE, either green, finely crystalline, very hard, minor inclusions of carbonaceous material, glauconite and pyrite or calcite, clear to pale green, fibrous with parallel oriented rods, 1 - 0.05 mm.

SANDSTONE, clear quartz and dark green glauconite together with minor amounts of pyrite.
Percentage glauconite ranges from 40-90%. Matrix ranges from 0-50% and is either grey shale or clear calcite.
Minor bands of SHALE and CARBONATE as above.

SHALE, dark grey, silty, slightly calcareous; pyritic (occasionally up to 25%), micaceous (up to 3%), carbonaceous (often occurring as flakes along bedding planes) and glauconitic (occasionally up to 15%), partly gradational with minor interbeds of:
SILTSTONE, grey; clear, coarse quartz silt (up to 60%), glauconite pellets, pyrite, carbonaceous material, mica in clay matrix.

CARBONATE, brown, very hard coarsely crystalline, slightly pyritic and carbonaceous.

SILTSTONE, grey, grey-brown comprising varying amounts of medium-coarse quartz silt, glauconite, pyrite, mica and carbonaceous material.

Gradational with minor interbeds of:
SHALE, dark grey, silty, slightly harder than siltstone. Slightly calcareous; comprising varying amounts of mainly very fine, quartz silt and very finely disseminated mica, carbonaceous material and pyrite (sometimes up to 70%).

Occasional bands of:
CARBONATE, pale brown, green-brown, very hard, finely crystalline, containing up to 25% dark green glauconite pellets, quartz silt, carbonaceous material and finely disseminated pyrite.

SILTSTONE, SANDSTONE, pale buff, very loosely consolidated; silt-very fine grained quartz. Minor amounts of pyrite, mica glauconite and carbonaceous material. Matrix is mostly soft, calcareous clay and comprises generally 25% of the rock.

SANDSTONE, brown to blue-grey, quartzose and oolitic. Ooids are mostly spherical, outer colour, blue-grey, pale blue, green with blue-grey and brown rings; chamosite; ½-1 mm diameter; minor pyrite cores.

SANDSTONE, pale buff and loosely consolidated to green brown and hard. Interbedded with: SHALE, dark grey, slightly silty calcareous and micaceous.

SAND, quartzose, clear milky pale pink and blue; coarse grained-granule and occasional pebble. Interbedded with: SHALE, dark grey-grey brown, silty.

QUARTZITE, white, blue, mainly clear quartz, very minor dark grains; dominantly well sorted, fine grained. Very minor white clay matrix (5%) very hard, cemented by silica. Bedding shown by very thin (less than 1 mm) dark grey shale bands.

No Fluorescence

Fishing Core — Rec 21 cm

P107/74 P108/74 P109/74 P110/74 P111/74 P112/74 P113/74

C.1. Rec. 1.35 m Dip 0°

C.2. Rec. 43 cm

C.3. Rec. 38 cm Dip 45°-50°

TOTAL DEPTH: 439.48 m

STRATIGRAPHIC COLUMN: Q-R; OODNADATTA FORMATION; COORIKIANA SS. MBR; BULLDOG SHALE; CADNA-OWIE FORMATION; ALGEBUCKINA SANDSTONE; ?ORDOVICIAN; ALBIAN; NEOCOMIAN; APTIAN; JURASSIC

L74—14 M. R. R. 141 Drn. B.T. — S. A. Dept. of Mines

Reduce to 11 inches

L74—14/4 FRAME 1

COMPOSITE WELL LOG
OODNADATTA TOWN BORE 2
MRR 141

Fig. 4 74/178

Drn. B.T. L74-14/4 Director of Mines Date: 25-2-76

COMPOSITE WELL LOG

SOUTH AUSTRALIAN DEPARTMENT OF MINES

OODNADATTA TOWN BORE 2

STATE SOUTH AUSTRALIA PETROLEUM TENEMENT: P. E. L. 5/6 1:250 000 MILE SHEET: OODNADATTA BASIN: Great Artesian.

WELL STATUS: Water Bore

HOLE SIZE:	INCHES	FROM (m)	TO (m)
	11 3/4	0	5.35
	5 1/8	5.35	435.5
Reamed	8	5.35	413.72
	5 1/8	435.5	437.67
	3.907	437.67	439.48

LOCATION: 27° 32′ 35″ S
135° 27′ 05″ E.

ELEVATION: GR: 120.8m
RT: 121.8m

DATE SPUDDED: 9th April, 1974
DATE DRILLING COMPLETED: 31st May, 1974
DATE RIG RELEASED: 5th June, 1974
TOTAL DEPTH: 439.48 m
CEMENT PLUGS: None

CASING:	INCHES	DEPTH (m)	CEMENTED TO	FROM (m)
	6	413.72	Surface	410

PETROPHYSICAL LOGS.

LOG	DEPTH (m) FROM	DEPTH (m) TO	SCALE
GAMMA RAY	0	439	1:500
	380	439	1:200
NEUTRON - NEUTRON	7	439	1:200
	380	439	1:200
SELF POTENTIAL	14	435	1:500
POINT RESISTIVITY	14	435	1:500
16" NORMAL RESISTIVITY	25	434	1:500
64" NORMAL RESISTIVITY	25	432	1:500
6' LATERAL RESISTIVITY	16	434	1:500
TEMPERATURE	0	435	1:500

N.B. LOGS RUN FROM GROUND LEVEL

LITHOLOGICAL REFERENCE

- Shale claystone
- Silty shale
- Siltstone
- Calcite
- Quartzite
- Q — Quartz grains
- Sandstone
- o — Pebble
- □ — Pyritic
- Py — Pyrite
- V — Micaceous
- ▪ — Carbonaceous
- Fe — Ferruginous
- Ca — Carbonate Fragments
- V — Glauconitic
- Gl — Glauconite
- H — Calcareous
- ⊙ — Oolitic
- F — Fossiliferous Fragmental or Indeterminate
- Gy — Gypsum Gypsiferous

→ Petrography Sample
← Palaeontology Sample

WELL SYMBOLS

- No. 3 — Core interval and number
- Casing shoe
- Plugged interval
- Fl — Fluorescence
- * — Cut with CCl_4

DRILLED BY: S.A. DEPARTMENT OF MINES

DRILLING METHOD: ROTARY

LOGGED BY: S.A. DEPARTMENT OF MINES

LITHOLOGY BY: R. C. N. Thornton and I. J. Townsend.

COMPILED BY: R. C. N. Thornton.

BIT RECORD: 1 AUGER 11 3/4"; 2. BOURNE 4 WING BLADE 5 1/8"; 3. VAREL VH2 ROLLER 5 1/8"; 4. VAREL VH2 ROLLER 5 1/8"

DRILLING RATE MINUTES/METRE: 0 10 20 30 40

TRACE

LITHOLOGY % OF CUTTINGS.

HYDROCARBONS

LITHOLOGICAL DESCRIPTION

CLAY, pale yellow-grey, and red ferruginised and slightly silty. Minor sand bands.

CLAY, yellow orange-grey, blue-grey, red silty slightly carbonaceous. Minor silt bands.

SANDSTONE, quartz, clear fine grained, cemented with either silica or iron (red) matrix.

CLAY, dark grey, very soft, sligtly silty, carbonaceous.

Approximately equal amounts (interbedded) of:
CLAY, dark grey, very soft-soft, carbonaceous, highly glauconitic. The pellets tend to occur in 1-2 mm aggregates, some of which are micaceous (speckled bronze) or cemented by pyrite.
And CLAY, very pale grey, yellow, pink, pale brown, orange, silty.

Minor amounts of:
CARBONATE, pale buff, pale green, green brown, hard containing abundant silt sized inclusions of glauconite and quartz.

GREENSAND, dark green, glauconite pellets, silt, very fine grain size, together with clear quartz grains of the same dimensions and very small flakes of mica (speckled red) set in a dark grey clay matrix.

CLAY, dark grey, medium hard, carbonaceous, containing glauconite pellets and minor silt.
CLAY, very pale grey, pink, yellow, medium hard silty (5-15%, mostly 10%)

CLAYSTONE, SILTSTONE, dark grey, ranging from silty claystone to clayey siltstone depending on amount of silt. Silt is fine, clear quartz. Usually up to 5% carbonaceous, pyritic and micaceous material disseminated throughout.

Minor GREENSAND, dark green glauconite pellets and clear quartz (ratio 50:50), fine to very fine grained.

CLAYSTONE, dominantly (80%) very pale grey, also yellow, pink, pale purple, brown, silty (up to 25%, mainly 5-15%), silt is quartz.

SHALE, dark grey, silty with up to 5% mica, pyrite and carbonaceous material finely disseminated throughout. Percentage silt is normally 5-10%.

Thin bands of CARBONATE, either green, finely crystalline, very hard, minor inclusions of carbonaceous material, glauconite and pyrite or calcite, clear to pale green, fibrous with parallel oriented rods, 1 - 0.05 mm.

SANDSTONE, clear quartz and dark green glauconite together with minor amounts of pyrite.
Percentage glauconite ranges from 40-90%. Matrix ranges from 0-50% and is either grey shale or clear calcite.
Minor bands of SHALE and CARBONATE as above.

SHALE, dark grey, silty, slightly calcareous; pyritic (occasionally up to 25%), micaceous (up to 3%), carbonaceous (often occurring as flakes along bedding planes) and glauconitic (occasionally up to 15%), partly gradational with minor interbeds of:
SILTSTONE, grey; clear, coarse quartz silt (up to 60%), glauconite pellets, pyrite, carbonaceous material, mica in clay matrix.

DEPTH (METRES): 0, 50, 100, 150, 200, 250

GAMMA RAY COUNTS PER SECOND: 0 10 20 30 40 50
SELF POTENTIAL MINUTES/METRE MILLIVOLTS: 10

CORES (RECOVERIES AND DIPS), PALAEONTOLOGY, PETROGRAPHY SAMPLES.

Fishing Core
Rec 21 cm
P107/74
P108/74

LITHOLOGY

CASING, PLUGS & TESTS

NEUTRON-NEUTRON COUNTS PER SECOND: 0 25 50 75 100 125 150
16" NORMAL RESISTIVITY, OHM METRES: 0 2 4 6 8 10 12

STRATIGRAPHIC COLUMN

Q-R

OODNADATTA FORMATION

COOKIKIANA SS. MBR

ALBIAN

10 CENTIMETRES ON ORIGINAL DRAWING

L 44-14/4

FRAME 2