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Record 1972/54

SHALLOW STRATIGRAPHIC DRILLING IN THE EASTERN SURAT BASIN, QUEENSLAND, 1966, 1967 and 1968

by

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503031

RECORD 1972/54

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SUMMARY

Fourteen of the BMR shallow stratigraphic holes drilled in the Surat Basin in 1966, 1967, and 1968 are described. Drilling totalled 884 metres, and coring 193 metres; 10 holes were wireline logged. Ten Jurassic and Cretaceous formations were drilled, and fresh rock obtained for petrological and palynological examination in areas of generally deep weathering and where outcrop identification of units is uncertain. Some fluvial sands, such as those of the Marburg Sandstone, are shown to have been weathered during deposition rather than during a more recent period. The sedimentary structures revealed in unresistant, virtually non-outcropping sediments, such as those common within the Bungil Formation, aid the understanding of their environments of deposition. Green, round, phyllosilicate grains in the Bungil Formation, which chemically are not glauconite, but are identical in appearance to grains common throughout the Rolling Downs Group, are suggested to be marine indicators.

INTRODUCTION

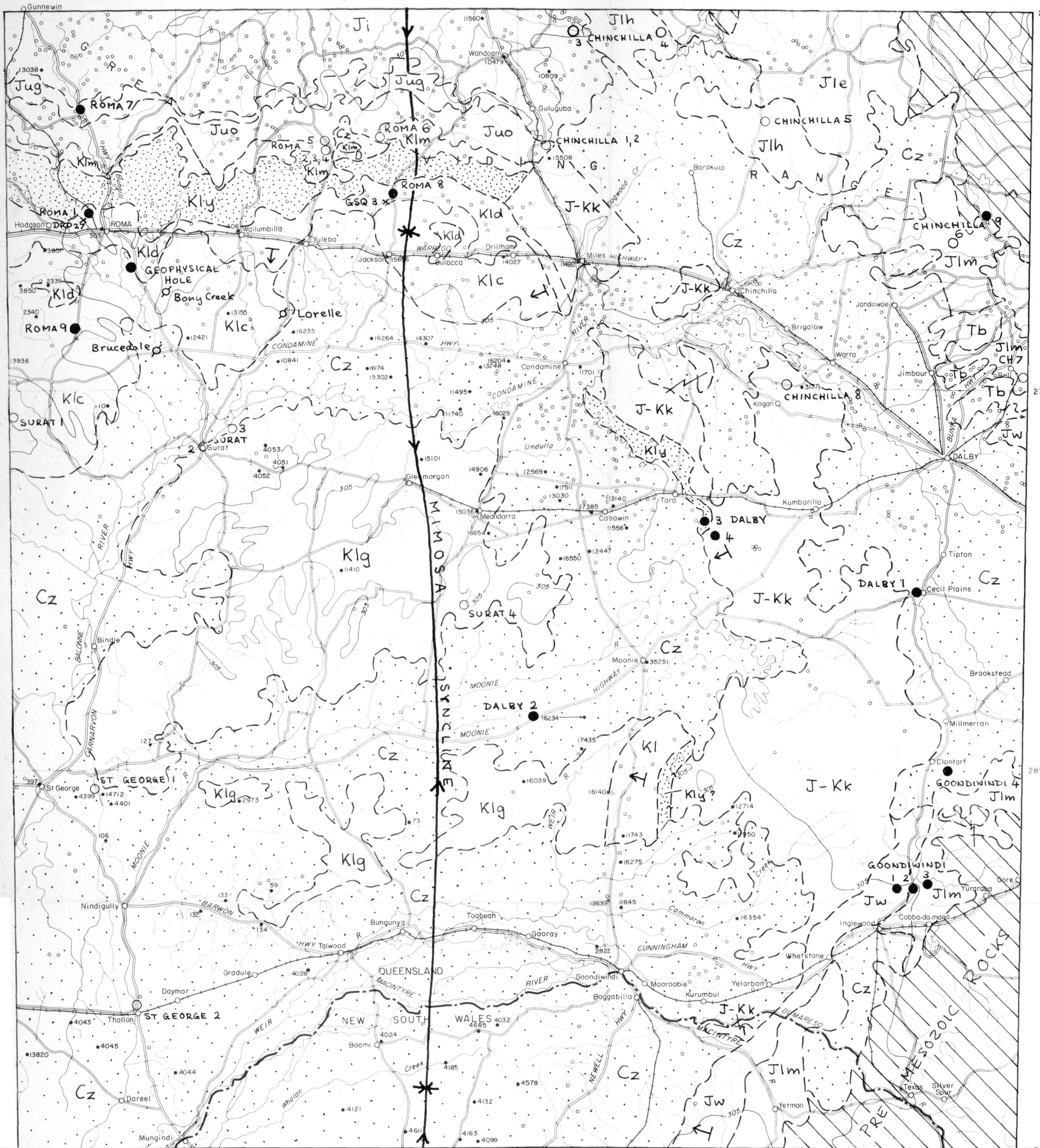
During 1967 the Surat Basin Party supervised the drilling of 20 shallow stratigraphic holes in the Surat Basin, most of which were documented by Exon, Reiser, Jensen, Burger, & Thomas (1968) and Thomas & Reiser (1968). Four holes drilled in the Roma Sheet area were not described and are dealt with here. Further information is also given for Roma No. 9, which was described by Thomas & Reiser (1968). Nine holes drilled in 1968 are also documented here; their stratigraphic significance and related micropalaeontological data are outlined by Exon, Mond, Reiser & Burger (1972). An electric log run in 1967 in a BMR seismic hole near AAO Richmond No. 1 is also presented (Fig. 9). The locations of these holes and those drilled in adjacent parts of the Surat Basin are shown in Figure 1.

Other BMR holes drilled in the Surat Basin have been described by Exon, Casey, & Galloway (1966); Exon, Milligan, Casey & Galloway (1967); and Mond & Senior (1970). Six holes drilled in the adjacent Warwick Sheet area in the Moreton Basin were discussed by Exon, Reiser, Casey, & Brunker (1969). Porosity and permeability data for Roma No. 1 were determined by Duff (1968a), and for Roma No. 9 by Duff (1968b).

Palynological reports relevant to the 14 holes discussed here are Burger (1967, 1968, 1972a, 1972b, in press) and Kemp (1972). Reports on Foraminifera were given by Terpstra (1968, 1972) on Roma No. 9 well and on the Dalby drilling respectively. Stratigraphic nomenclature used is by Exon (1971) and Reiser (1970), and palynological nomenclature by Evans (1966).

The stratigraphic sequence is shown in Table 1. Crook's (1960) classification of arenites is followed (see also Fig. 14). The abbreviations and symbols used on the lithological logs are shown in Table 7 and Figure 14, respectively.

LOCALITY MAP - STRATIGRAPHIC DRILL HOLES



CAINOZOIC	Cz	Sediment
	Tb	Tertiary basalt
LOWER CRETACEOUS	Klg	Griman Creek Formation
	Kl	undifferentiated
	Kly	Bungil Formation
	J-Kk	Kumbarilla Beds
	Klm	Mooga Sandstone
JURASSIC	Juo	Orallo Formation
	Jug	Gubberamunda Sandstone
	Js	Springbok Sandstone
	Ji	undifferentiated Injune Creek Group
	Jw	Walloon Coal Measures
	Jlm	Marburg Sandstone
	Jlh	Hutton Sandstone
	Jle	Evergreen Formation

20 0 20 40 60 miles

20 0 20 40 60 80 100 kilometres

- ● Stratigraphic drill hole discussed in this Record
- ○ Other BMR stratigraphic drill holes
- o Water bore
- • Gamma-ray logged water bore, with registered number
- × Queensland Mines Department stratigraphic drill hole
- Petroleum well
- Shallow regional dip

FIG. 1

To accompany Record 1972/54

Q/A/404

Table 1 - Stratigraphic sequence in area of Figure 1

Approximate Age	Name	Normal thickness (metres)	Intersected in	Figure No.
Albian	Griman Creek Formation	0-150	Dalby No. 2	13
	Surat Siltstone	30-50	Dalby No. 2	13
	Wallumbilla Formation			
	Coreena Member	60-150	S.H. $499^{3}/12$	11
			Roma No. 9	12
Aptian	Doncaster Member	60-120	Roma No. 1	8
			S.H. $499^{3}/12$	11
			Roma No. 9	12
	Bungil Formation	60-120	Roma No. 1	8
			Roma No. 8	9
			Dalby No. 3	10
	Minmi Member	15-60	Roma No. 1	8
			S.H. $499^{3}/12$	11
Neocomian	Nullawurt Sandstone Member	15-25	Roma No. 1	8
	Kingull Member	15-30	Roma No. 1	8
	Mooga Sandstone	20-100	Roma No. 1	8
			Dalby No. 4	7
Upper Jurassic	Orallo Formation	30-150		
	Gubberamunda Sandstone	30-100	Roma Nos. 7 & 7A	6
	Westbourne Formation	15-120	Roma Nos. 7 & 7A	6
	Springbok Sandstone	15-120	Dalby No. 1	5
Middle Jurassic	Walloon Coal Measures	30-300	Goondiwindi No. 4	4
Lower Jurassic	Marburg Sandstone	200-500	Chinchilla No. 9	2
			Goondiwindi No. 3	3
			Goondiwindi No. 4	4
			Goondiwindi No. 1	Table 5
			Goondiwindi No. 2	Table 5

DRILLING AND LOGGING

The drilling statistics of that part of the 1967 drilling dealt with here are outlined in Table 2, and the statistics of the 1968 Surat Basin drilling in Table 3. The standard of lithological logging for each hole (well site or laboratory), the well site geologist responsible for each hole, and the geologist responsible for laboratory logging are given in Table 4. As the holes were logged in different ways, some only at the well site, some only with a binocular microscope in the laboratory, and some both at the well site and in the laboratory, the accuracy of the resultant logs is variable. Other factors in the accuracy of the logging are the amount of coring, and the amount of air drilling (which gives much better cuttings than drilling with mud), and whether or not good wireline logs were available to help in interpretation of the cuttings collected. Cores and cuttings are held at the BMR Core & Cuttings Laboratory, Fyshwick, A.C.T.

Table 2 - 1967 Drilling (Roma 1:250 000 Sheet area)

Hole No. (1:250 000 Sheet area)	10 000 Yard Grid. Ref.	Total depth (m)	Drilling (m)	Coring (m)	No. of cores	Core recovery Actual (m)	Core recovery %	Wireline logs
Roma 1*	154703	126	19	107	40	97	91	SP, R
Roma 7	151735	49	40	9	3	7	77	-
Roma 7a	151735	60	57	3	1	2	78	SP, R
Roma 8	251710	81	66	15	5	11	72	SP, R
Roma 9	150664	109	98	11	4	10	89	SP, R
Total	-	425	280	145	53	127	88	8

*Drilled during 1966 (Exon, Milligan, Casey, & Galloway, 1967); redrilled and electrically logged during 1967. SP = self potential; R = Resistivity; G = Gamma ray.

Table 3 - 1968 Drilling

Hole No. (1:250 000 Sheet area)	10 000 Yard Grid. Ref.	Total depth (m)	Drilling (m)	Coring (m)	No. of cores	Core recovery Actual (m)	Core recovery %	Wireline logs
Chinchilla 9	441703	97	82	15	5	11	72	-
Dalby 1	419584	97	85	12	4	9	75	G, SP, R
Dalby 2	298543	106	97	9	3	6.5	70	G
Dalby 3	352606	64	61	3	1	3	100	G
Dalby 4	355602	52	52	0	0			G, SP, R
Goondiwindi 1	415489	21	21	0	0			-
Goondiwindi 2	419489	12	12	0	0			-
Goondiwindi 3	424490	82	76	6	2	4.5	75	SP, R
Goondiwindi 4	431526	120	114	6	2	4	70	G, SP, R
Total	-	652	604	51	17	39	77	13

Rigs of the Petroleum Technology Section of the BMR were used in both years, and the driller was J. Kuenen. In 1967 the rig used was a Mayhew 1000, with 500 feet of drill pipe, a ten-foot core barrel and equipment for drilling with mud. In 1968 the rig was a Fox-Mobile with 400 feet of drill pipe, a ten-foot core barrel, and mud-drilling facilities. In both years a Widco Portalogger with electric and gamma probes recovered logs from some holes (see figures and Tables 2 & 3). P. Mann of the Geophysical Branch carried out the logging of some of the 1968 holes, but otherwise the logging was done by the well site geologist. The logger yielded some logs from all ten holes attempted, but of the thirty possible logs (gamma ray, self potential, single point resistivity) only 21 were actually obtained because of instrument failures.

STRATIGRAPHIC RESULTS

Marburg Sandstone

The Marburg Sandstone was intersected in Chinchilla No. 9 and Goondiwindi Nos 3 and 4 (Figs 2, 3, 4), up to 100 m being penetrated. The formation was shown to consist of a rather monotonous sequence of clayey quartzose to labile sandstone grading in places to siltstone and mudstone. Coarser-grained beds are thickly bedded and cross-bedded, whereas finer-grained beds are relatively thinly bedded and well bedded. Size sorting varies from poor to good, being better in the finer-grained beds, and grains are generally subangular or subrounded. In general, in Chinchilla 9 and Goondiwindi 4 for example, average grainsize decreases upwards, siltstone and mudstone being concentrated higher in the sequence. At some levels these fine-grained rocks contain carbonaceous debris, and even grade into coal. Recognizable plant debris occurs in the siltstone and mudstone and on partings in the finer-grained sandstone, but spores and pollens of Evan's (1966) unit J1 are generally poorly preserved (Burger, 1972a).

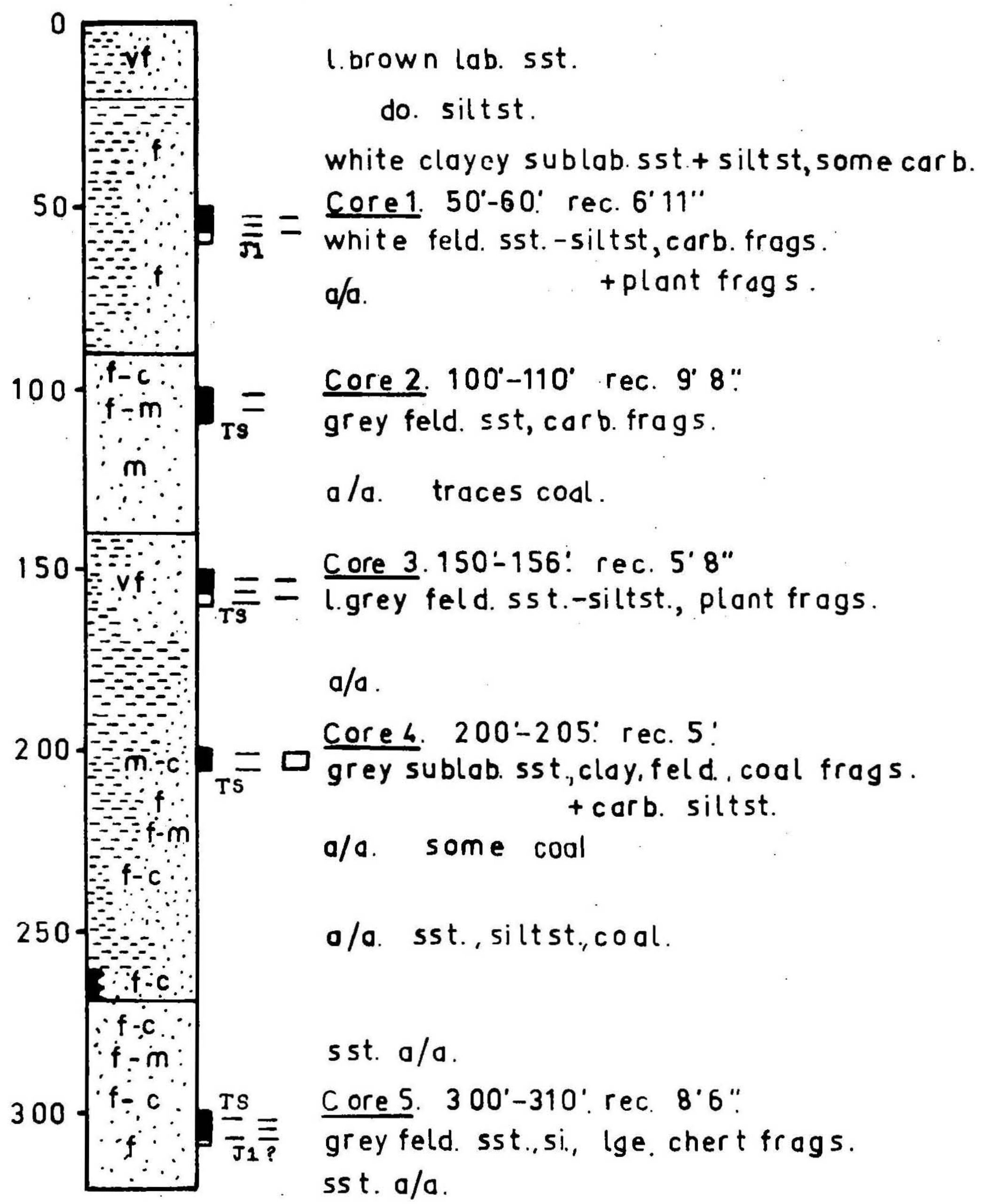
Four thin sections from Chinchilla No. 9 (Exon & Smart, 1972) show that quartz (20 - 70%), rock fragments (up to 50%), mica (up to 30%), feldspar (up to 10%), and clay matrix (20 - 50%) are the dominant constituents. The 'clay matrix' appears to be largely weathered rock fragments. These sandstones were highly lithic on deposition but post-depositional (not recent) weathering has largely broken down the lithic fragments to clay. The depth of recent weathering in all holes is 40 to 50 feet (12 - 15 m). Porosities are very variable and a few beds are calcareous.

Two holes in the Marburg Sandstone, Goondiwindi Nos 1 and 2 (Table 5), were abandoned at shallow depths, No 1 because it struck Palaeozoic basement at 30 feet (9 m), and No 2 because it encountered flowing water at 25 feet (8 m). In both the dominant lithology was sandstone which varied from medium-grained to very coarse and pebbly and from quartzose and clean to very clayey.

DRILL HOLE B.M.R. CHINCHILLA No. 9.

MARBURG SANDSTONE.

Water - drilling below 150ft, weathered to 50ft



Depths in feet

G56/A9/19 to accompany Record 1972/64

FIG. 2

Table 4 - Lithological Logging

Hole No.	Drilling supervised by	Logged in field	Binocular microscope logging in lab.	Thin sections available
Roma 1	E.N. Milligan	Yes	-	No
Roma 7 & 7A	D. Burger	Yes	N.F. Exon	No
Roma 8	D. Burger, N. Exon	Yes	N.F. Exon	Yes
Roma 9	B.M. Thomas, R.F. Reiser	No	B.M. Thomas, N.F. Exon	No
Chinchilla 9	R.F. Reiser	No	N.F. Exon	Yes
Dalby 1	A. Mond	Yes	N.F. Exon	Yes
Dalby 2	A. Mond, N.F. Exon	Yes	-	Yes
Dalby 3	N.F. Exon	Yes	-	Yes
Dalby 4	N.F. Exon	Yes	-	No
Goondiwindi 1	A. Mond	Yes	-	No
Goondiwindi 2	A. Mond	Yes	-	No
Goondiwindi 3	R.F. Reiser	No	J. Smart	No
Goondiwindi 4	R.F. Reiser	No	N.F. Exon	No

Table 5 - BMR Goondiwindi Nos 1 & 2 - Marburg Sandstone

BMR Goondiwindi No 1

0 - 15' (0-5m) c.quartzose brown sand

15 - 30' (5-9m) v.c pebbly quartz sandstone, light olive grey

30 - 67½' (9-21m) Palaeozoic 'chert', greenish black

T.D. 67½' (21m) No gamma ray log

BMR Goondiwindi No 2

0 - 7' (0-2m) Brown soil

7 - 20' (2-6m) m - c quartz sandstone, pebbly, yellow-orange

20 - 22' (6-7m) m. clayey sandstone, light grey

22 - 40' (7-12m) m - c quartz sandstone, pale yellow-orange, pebbly.

25' (8m) Water supply

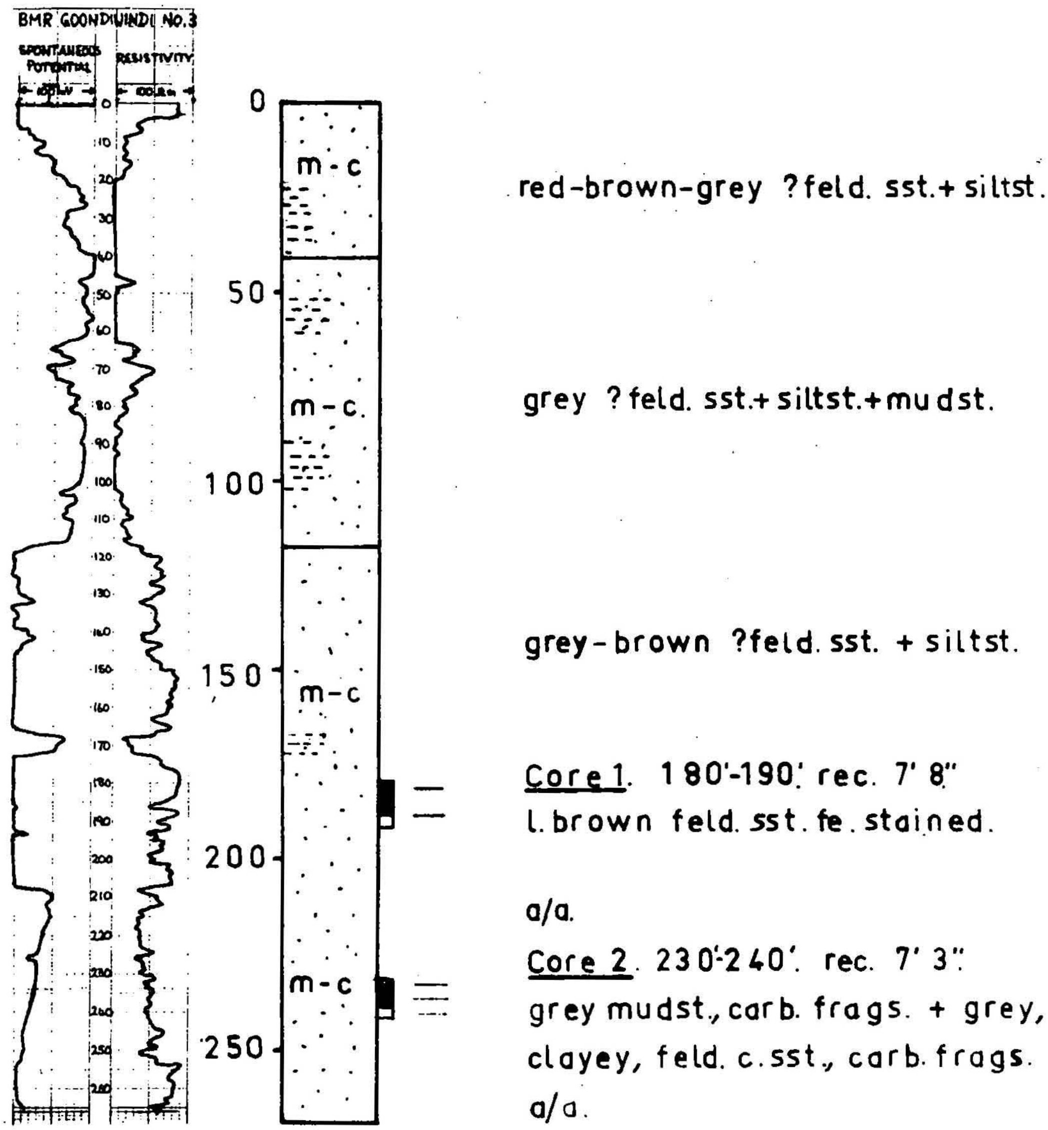
30 - 40' (9-12m) Flowing water, had to abandon hole.

T.D. 40' (12m) No gamma ray log.

DRILL HOLE B.M.R. GOONDIWINDI No 3.

MARBURG SANDSTONE.

Water-drilling below 40 ft, weathered deep, hard to distinguish from post depositional weathering.



Depths in feet

H56/A1/2 to accompany Record 1972/54

FIG. 3.

The provenance for the Marburg Sandstone in the Surat Basin was the igneous and metamorphic rocks of the Yarraman Block and the Texas High. Deposition initially was completely by fast-flowing streams, but stream velocities diminished later and some lake and swamp deposits also accumulated.

Walloon Coal Measures

The lower 140 feet (43 m) of the Walloon Coal Measures was penetrated in Goondiwindi No. 4 (Fig. 4). The sequence consists of grey clayey siltstone, mudstone, sandstone and coal. The mudstone is generally carbonaceous and grades into coal, which is vitreous and, on the evidence of the wireline logs, in seams a metre and more thick. The sandstone is very fine to fine-grained, grey, very clayey and consists of about 50% quartz and 5% dark lithic fragments in a 'clay' matrix which probably consists largely of broken-down labile grains, as is the case with the Marburg Sandstone.

The deposits are of stream, lake, and swamp origin.

Springbok Sandstone

Dalby No. 1 (Fig. 5) was drilled entirely in the Springbok Sandstone * to a depth of 316 feet (96 m). The monotonous sequence consists almost entirely of thinly to thickly bedded, cross-bedded, medium-grained sandstone. The sandstone is grey when fresh, varicoloured in the recent weathering zone, very clayey, and lithic sublabile to lithic. It is porous in part, containing water below 30 feet (9 m), and shows the effects of recent weathering to a depth of 140 feet (43 m).

Thin sections from the three deeper cores (Exon & Smart, 1972) show that the sandstone consists essentially of 25 to 35% quartz, 25 to 40% volcanic rock fragments, 5% feldspar, 5% almandine garnet, and 20 to 30% clayey matrix. Biotite, chlorite, and magnetite (20% in one core) are common accessories.

This sequence consists of stream sediments.

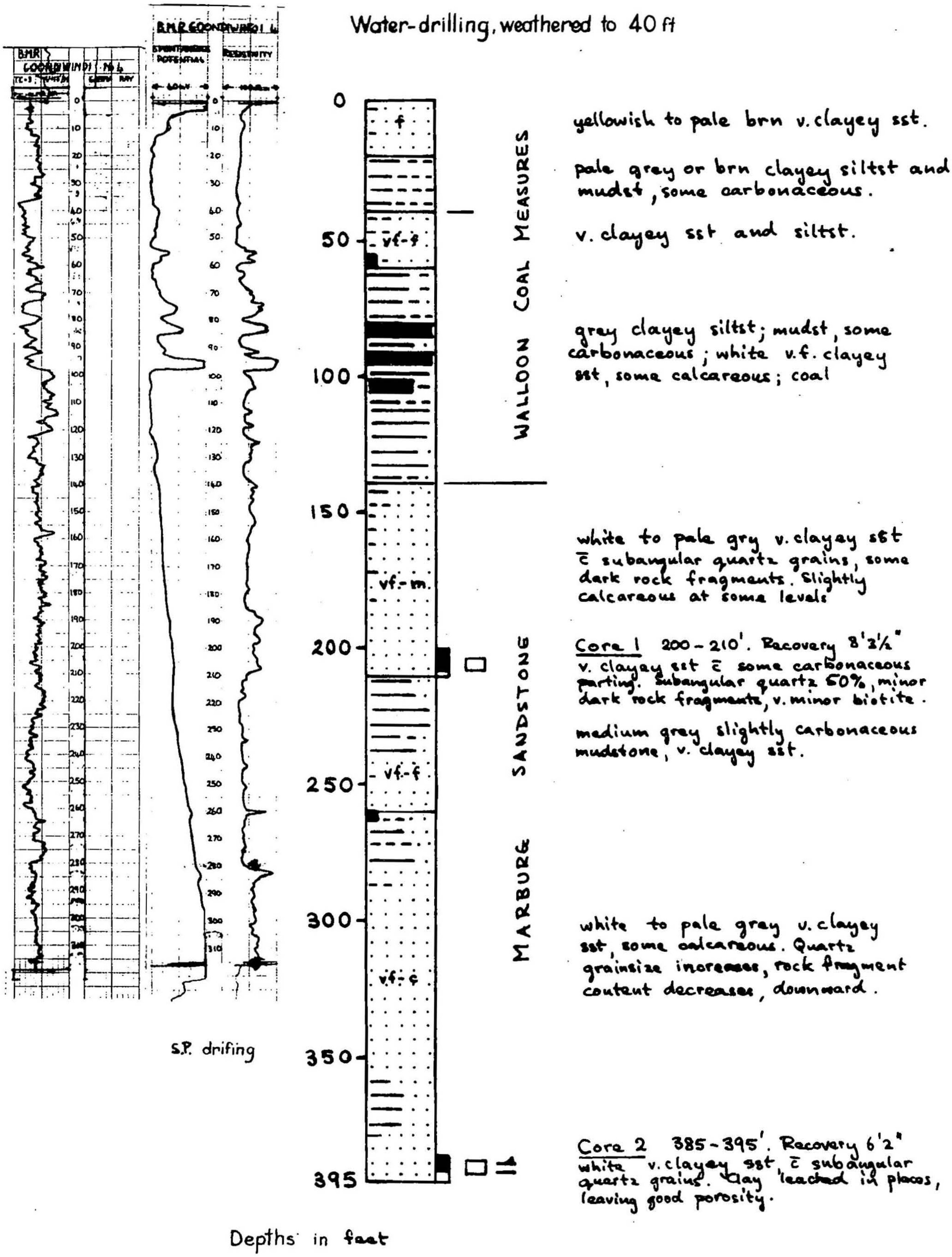
Westbourne Formation

Roma Nos 7 & 7A (Fig. 6) penetrated the upper 116 feet (35 m) of the Westbourne Formation below the Gubberamunda Sandstone. The sequence consists of fresh grey siltstone interbedded with sandstone. The siltstone grades to mudstone and is slightly micaceous and, in places, slightly carbonaceous. It is generally laminated to thinly bedded, and shows cross-lamination and compaction features. The subordinate sandstone is laminated to medium-bedded, cross-laminated or cross-bedded. It is very fine to fine-grained with subangular to subrounded grains, varies from porous to quite clayey, and is quartzose to sublabile. Accessory minerals include muscovite and biotite.

*Included in this area in the undifferentiated Kumbarilla Beds, because of mapping difficulties.

DRILL HOLE BMR GOONDIWINDI No 4

WALLOON COAL MEASURES AND MARBURG SANDSTONE



H56/A1/3 to accompany Record 1972/54

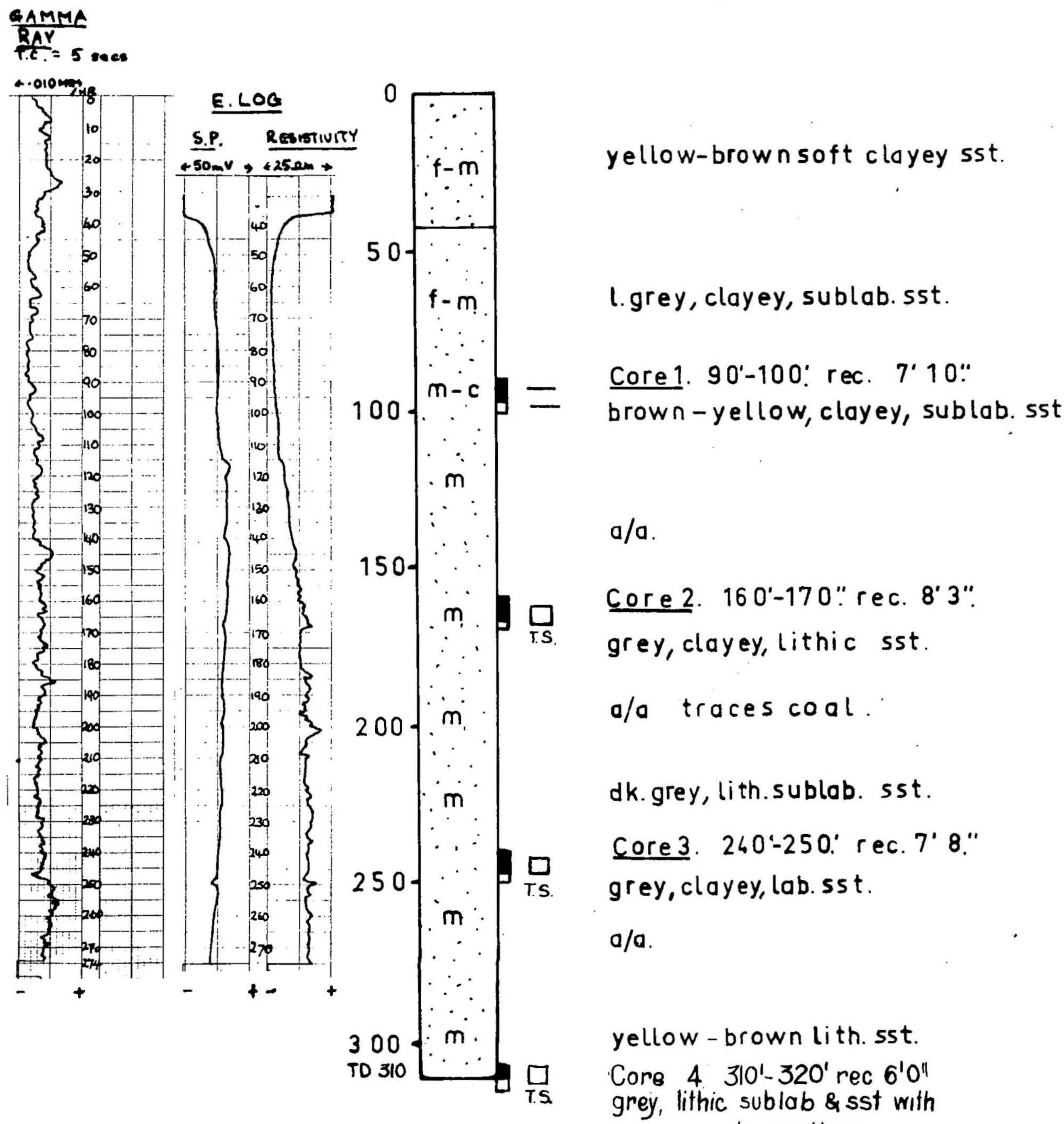
FIG 4

DRILL HOLE B.M.R. DALBY No. 1.

SPRINGBOK SANDSTONE

(mapped as part of the Kumbarilla Beds)

Water-drilling below 40 ft, weathered to 140 ft



Depths in feet

G56/A13/14 to accompany Record 1972/54

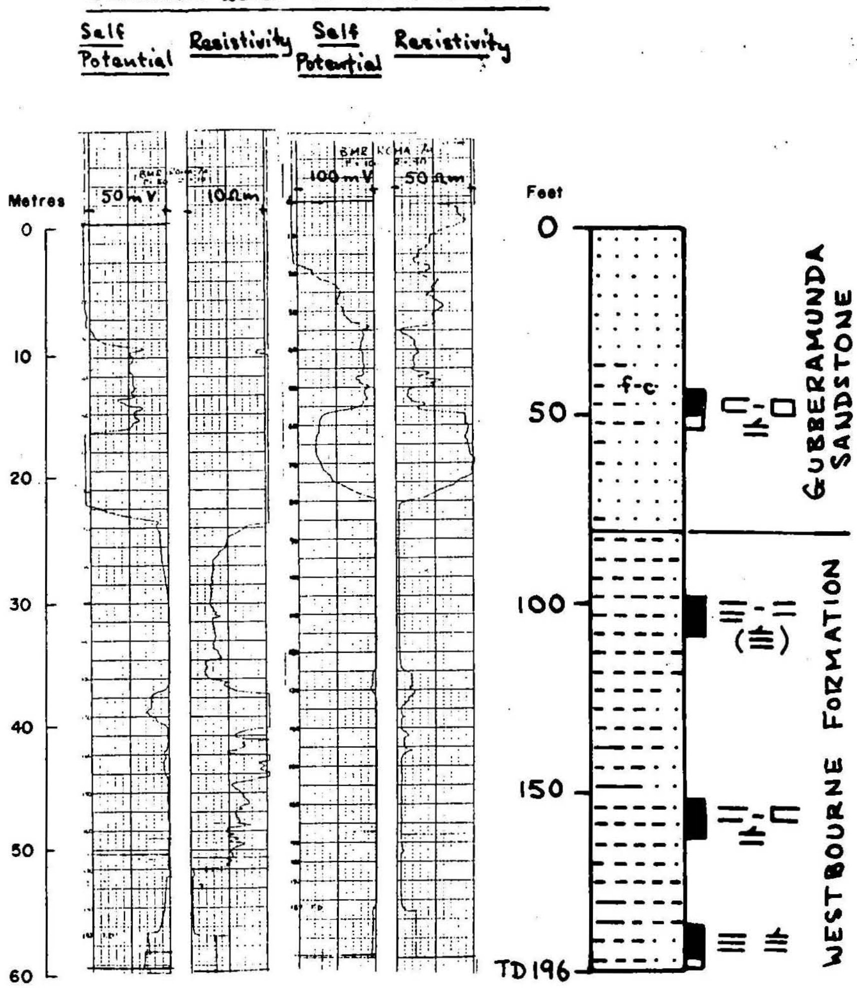
FIG. 5

DRILL HOLES BMR ROMA NOS 7&7A

WESTBOURNE FORMATION AND GUBBERAMUNDA SANDSTONE

Both holes drilled at the same site ; Roma 7 to only 162'
Water-drilling below 110 feet
Weathered to 80 feet

ELECTRIC LOGS OF BMR ROMA 7A



Brownish quartzose sst, pale gry siltst

Core 1 45-55' Recovery 6'6"
porous ironstained quartzose sst c̄ subang quartz, minor rock frags, felds, clay matrix. pale gry siliceous siltst ≡ and ≦

Core 2 99-109' Recovery 9'
medium gry sl. micaceous siltst grading to v.f. sst.

Muddy siltst, siltst and v.f.-f sst. well laminated and Xlaminated. Disturbance of bedding by minor faults (compaction).

Core 3 152-162' Recovery 9'
pale gry siltst and quartzose to sublabile f sst c̄ muscovite, biotite.

7A/Core 1 186-196' Recovery 7'5"
medium gry siltst and pale gry v.f. sst. Sst clayey but porous. Siltst sl. carbonaceous and micaceous.

These deposits, with their lack of carbonaceous matter and with their distinctive internal structures, are probably shallow marine.

Gubberamunda Sandstone

Roma Nos. 7 & 7A (Fig. 6) penetrated the lower 80 feet (24 m) of the Gubberamunda Sandstone comprising weathered sandstone with subordinate siltstone. The upper 30 feet (9 m) are almost entirely sandstone, the middle 25 feet (8 m) are interbedded sandstone and siltstone, and the lower 25 feet (8 m) are almost entirely sandstone. The sandstone is thickly bedded, cross-bedded, and fine to coarse-grained. It is generally leached and ironstained, consisting essentially of subangular to subrounded quartz grains with a little interstitial clay and very minor muscovite, dark rock fragments, and feldspar. The interbedded, medium-bedded siltstone is siliceous and generally pale grey.

These deposits were probably laid down by streams which advanced over a coastal plain consisting of Westbourne Formation sands and silts, during a period of marine regression.

Mooga Sandstone

Parts of the Mooga Sandstone were penetrated in Dalby No. 4 and Roma No. 1 (Figs. 7 & 8).

The 170 feet (52 m) penetrated in Dalby No. 4 (Fig. 7) consist of clayey sandstone, siltstone grading to mudstone, and minor coal, which has been assigned to the Mooga Sandstone but could possibly be the lower part of the Bungil Formation. The sandstone is yellow, grey, or buff where weathered (above 15 m) and grey or greenish grey where fresh; it is lithic and contains feldspar, green and black rock fragments, and red garnet?. Cuttings from 80 to 90 feet (24-27 m) contain a K1a microflora of early Cretaceous age (Kemp, 1972).

The continuously cored upper 18 m of the Mooga Sandstone in Roma No. 1 (Fig. 8) is all sandstone and represents the upper half of the unit. It contains K1a spores of early Cretaceous age (D. Burger, pers. comm.)

From 355 to 385 feet (108-117 m) it is pale grey, largely fine-grained, and sublabile to labile. It is thinly bedded and cross-laminated and, on the evidence of the electric log (Fig. 8), has little porosity. Core analyses (Duff, 1968a) show effective porosities from 18 to 24% and virtually no permeability. Thin bioturbated beds and plant-rich layers occur at some levels.

Below 385 feet (117 m) the Mooga Sandstone is fine to coarse-grained and sublabile to quartzose. It is thickly bedded to massive and in part faintly cross-bedded. Some beds are porous and some contain small calcareous concretions. Thin beds of fine gravel are present at various levels. The electrical log (Fig. 8) indicates relatively high porosity, and core analyses (Duff, 1968a) show effective porosities of 12 to 29% and horizontal permeabilities from nought to 33 millidarcies.

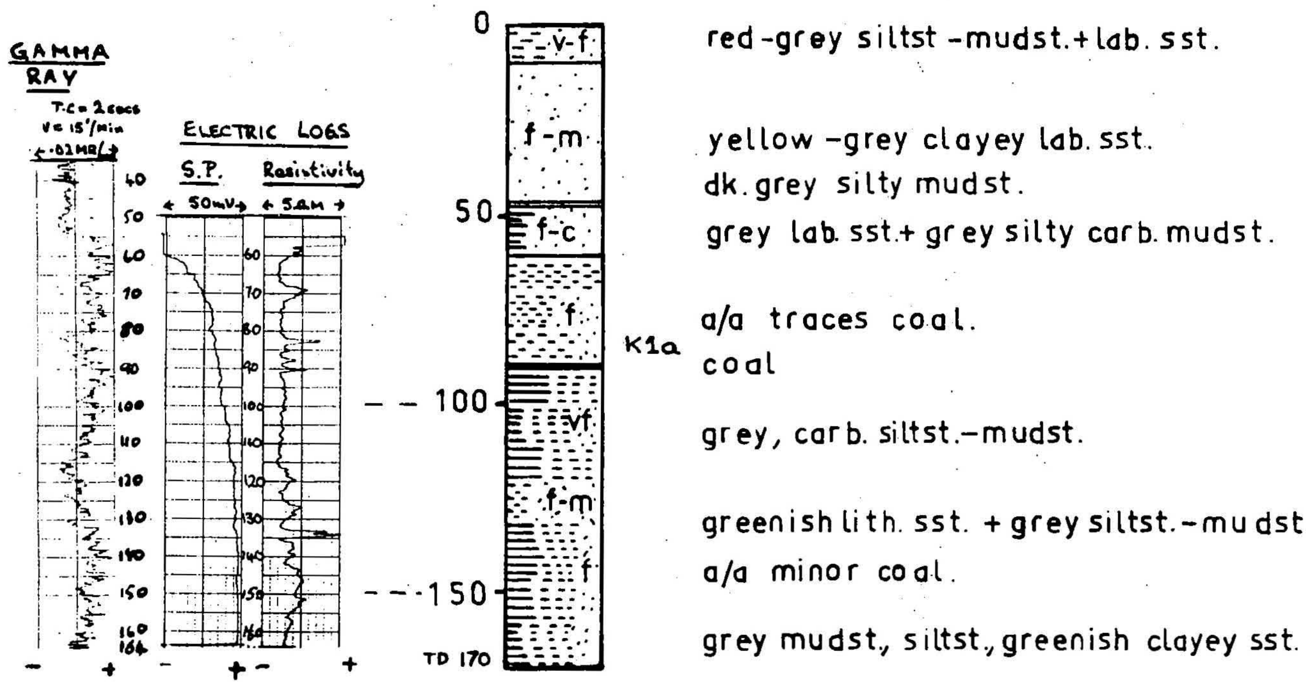
DRILL HOLE B.M.R. DALBY No. 4.

MOOGA SANDSTONE

(Mapped as part of the Kumbarilla Beds)

Water-drilling below 100 feet

weathered to 50 ft.



Depths in feet

G56/A13/15 to accompany Record 1972/54

FIG. 7

Table 6 - Cretaceous Thicknesses in the Roma Area (in metres)

BASIN MARGIN (WEST TO EAST)*				
Well	Structural position	Doncaster Member	Bungil Formation	Mooga Sandstone
BMR Mitchell 11	Roma Shelf	-	80	-
DRD 27 (Roma)	Roma Shelf	-	106	60
BMR Roma 1	Roma Shelf	-	93	-
BMR geophysical hole	Roma Shelf	91	-	-
AAO Bony Creek 1	Roma Shelf	114	102	139
GSQ Roma 3	Mimosa Syncline	-	93	71
BMR Roma 8	Mimosa Syncline	-	81	-

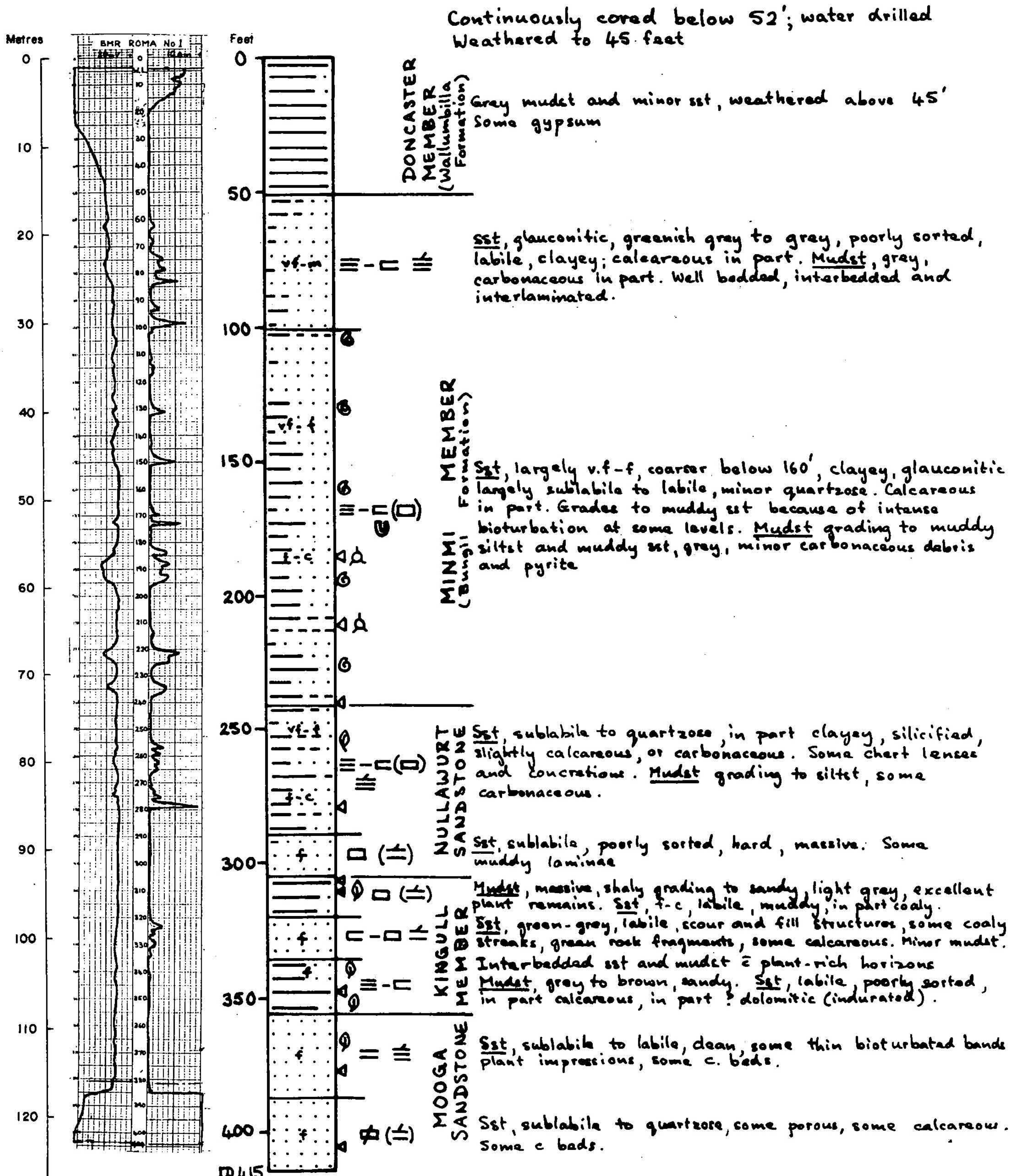
FURTHER INTO BASIN (WEST TO EAST)*

AAO Brucedale 1	Roma Shelf	83	125	150
AAO Lorelle 1	Mimosa Syncline	165	131	124

* Exact locations are on Figure 1.

DRILL HOLE BMR ROMA NO. 1

BUNGIL FORMATION AND MOOGA SANDSTONE



◁ Sample with Kla microflora

Sample with dinoflagellates

N.B. Bungil Formation contains Minmi Member, Nullawurt Sandstone Member, Kingull Member

FIG 8

To accompany Record 1972/54 G55/A12/18

The Mooga Sandstone is considered to be fluvial. Its thickness varies considerably (between 60 and 150 m in the Roma area - see Table 6).

Bungil Formation

The Bungil Formation was completely penetrated in Roma No. 1 (Fig. 8), and parts of the sequence were penetrated in Roma No. 8, Dalby No. 3, and BMR Seismic Shot-hole 449[3]/12 (Figs. 9, 10, & 11).

In the continuously cored Roma No. 1 (Fig. 8) three members could be recognized: Kingull Member, Nullawurt Sandstone Member, and Minmi Member.

The lowermost (Kingull) member consists of 50 feet (15 m) of mudstone and labile sandstone. The mudstone is generally massive, but is well laminated in places, grey and carbonaceous, and is sandy in part. It includes well-preserved plant remains, including a recognizable *Taeniopteris* flora with probable *Equisitum* heads and bracts between 305 and 310 feet (93-94m). The sandstone is greyish green, generally labile, and fine to coarse-grained. Green rock fragments are abundant. It is medium to thickly bedded and commonly shows scour-and-fill structure. It is muddy and carbonaceous, with plant remains at some levels, and with some calcareous and dolomitic horizons. A few small chert nodules are present between 310 and 319 feet (94-97m). The electric logs suggest generally low porosity, but core analyses (Duff, 1968a) show effective porosities of 19 to 26% and horizontal permeabilities of 2 to 24 millidarcies. The Kingull Member is believed to be lacustrine.

In Roma No. 1 (Fig. 8) the overlying Nullawurt Sandstone Member is 60 feet (18 m) thick and consists of sublabile to quartzose sandstone, and lesser mudstone grading to siltstone. The generally fine-grained sandstone is mostly thin to medium-bedded, but is thick-bedded low in the member. Cross-lamination and cross-bedding are fairly widespread. Carbonaceous flecks and recognizable plants occur at some levels. Some beds are calcareous, and chert lenses and concretions occur between 270 and 280 feet (82-85m). The mudstone and siltstone are massive to interlaminated, and grey. Plant debris is abundant at some levels and a cherty plant-bearing bed occurs at 255 feet (78m). The electric logs suggest variable porosity, and core analyses (Duff, 1968a) show effective porosities of 18 to 26% and horizontal permeabilities of nought to 24 millidarcies. The environment of deposition of the member was probably largely lacustrine.

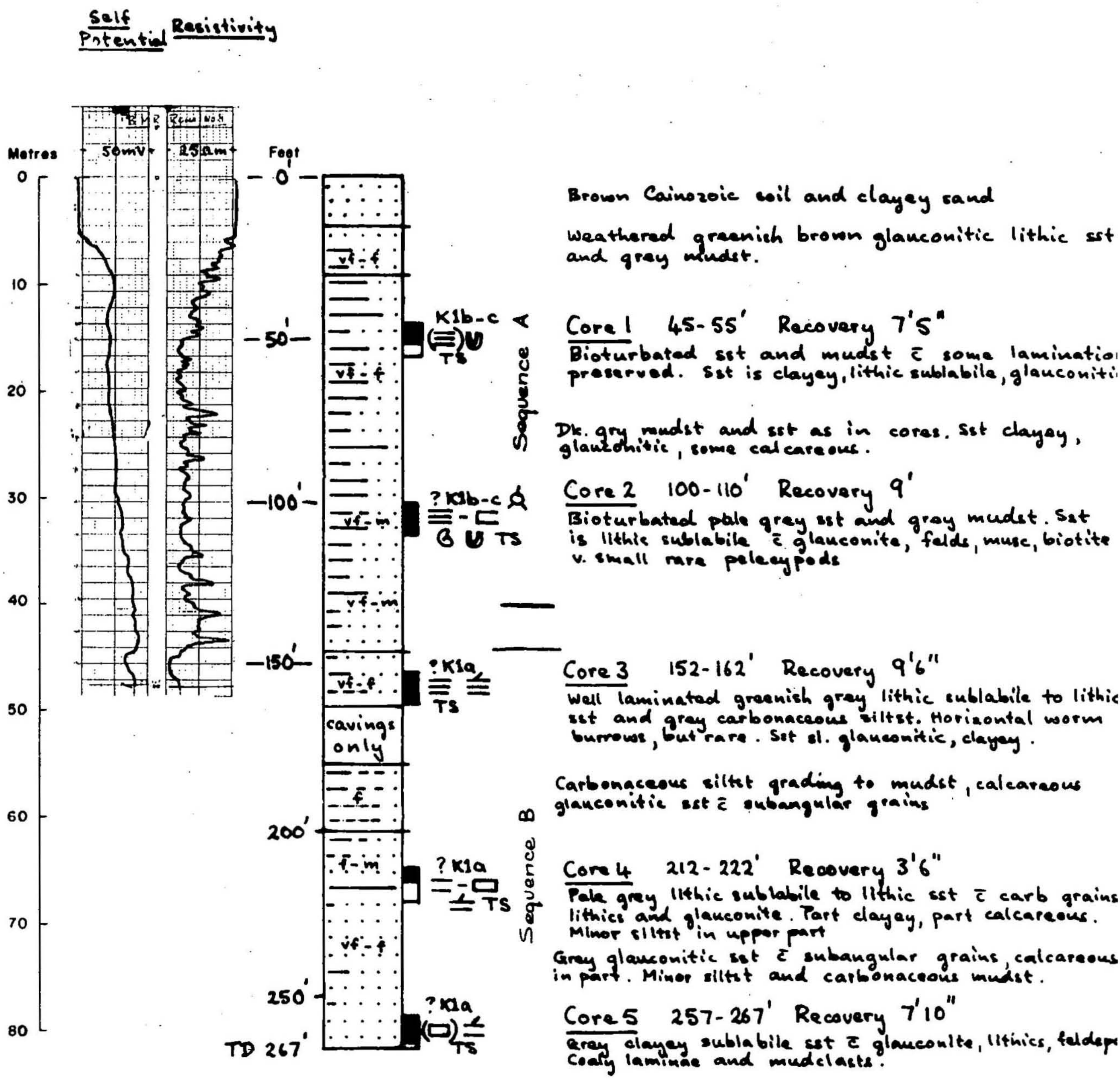
The uppermost member in Roma No. 1 (Fig. 8) is the 190 feet (58m) thick Minmi Member, which was laid down in shallow marine conditions, and unlike the other members contains 'glauconite'*, marine macrofossils, and Radiolaria. It consists of greenish-grey to grey sublabile sandstone, with

*Footnote: The term 'glauconite' is used throughout this Record in a field sense for green grains consisting of phyllosilicates. In thin section they vary from round and dark with a granular internal texture, to yellowish flaky and intergranular; X-ray diffraction shows that they are largely montmorillonite (Appendix).

DRILL HOLE BMR ROMA NO 8

BUNGIL FORMATION

Water-drilling throughout
Weathered to 40 feet



To accompany Record 1972/54

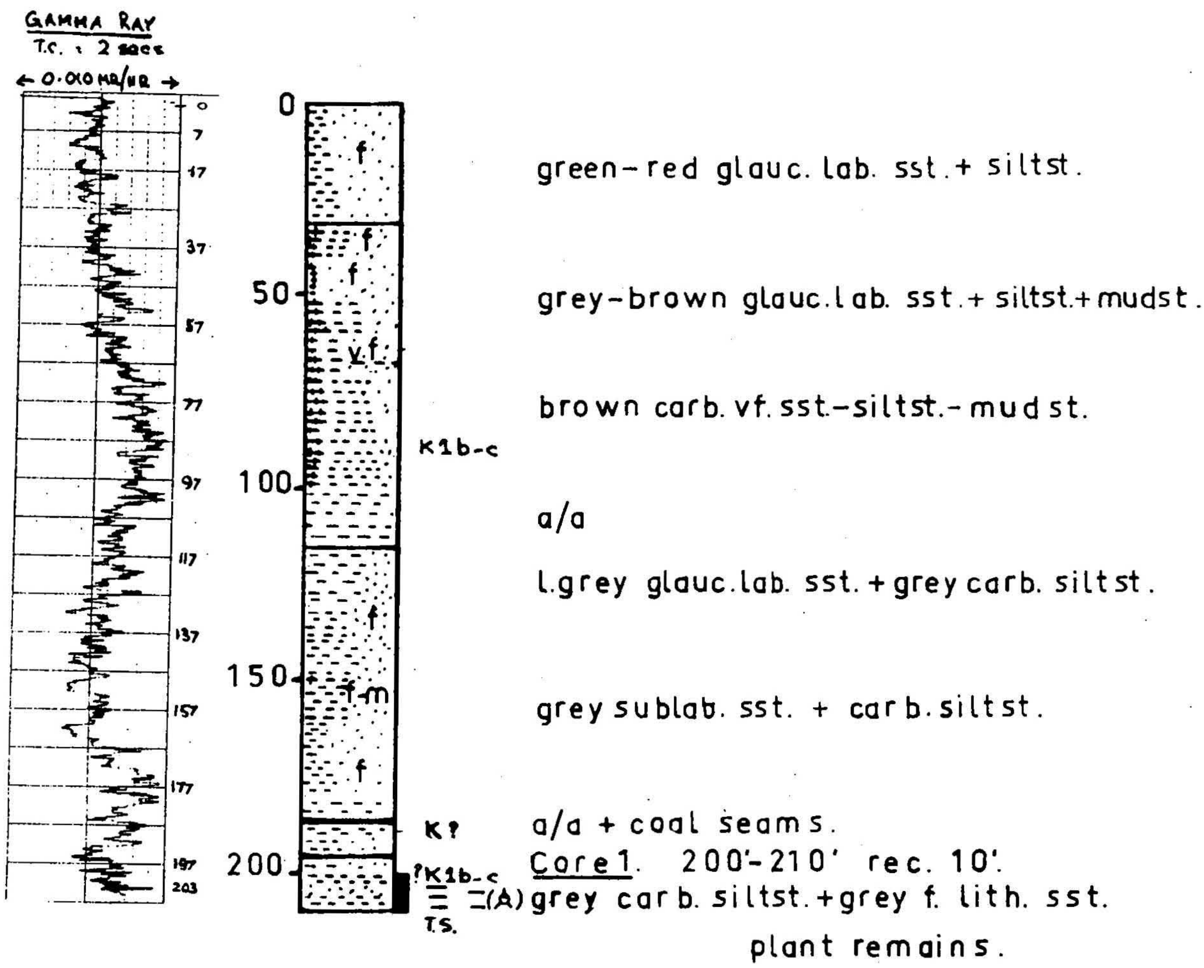
G55/A12/19

FIG. 9

DRILL HOLE B.M.R. DALBY No. 3.

BUNGIL FORMATION

Air-drilling throughout, some water entered hole at 190 ft
weathered to 65 ft



Depths in feet

(A) Rare dinoflagellates present

lesser grey mudstone grading to siltstone. The uppermost 15 m consist of well bedded sediments, whereas the remainder of the sequence is extensively bioturbated and contains little well preserved bedding. The very fine to coarse-grained sandstone varies from labile to quartzose and from poorly to well sorted. It is calcareous in part, and commonly muddy. The mudstone and siltstone, which are commonly sandy, are carbonaceous in part and contain pyrite. The electric logs suggest variable porosity and core analyses (Duff, 1968a) show effective porosities varying from 12 to 32% and horizontal permeabilities varying from nought to 1760 millidarcies.

It is here suggested that the lower bioturbated part of the sequence was deposited in near-shore environments, whereas the upper well bedded part was deposited farther offshore. The muds of the overlying Doncaster Member were probably deposited in water depths exceeding 20 m.

Roma No. 8 (Fig. 9) penetrated some 250 feet (75 m) of Bungil Formation sediments (i.e. about 90% of the entire Bungil Sequence in the vicinity) in the Mimosa Syncline. The petrography of these sediments is discussed in detail in the appendix. The upper half of the sequence is bioturbated and the lower part well bedded. The sandstone is greenish grey to grey, sublabile to labile, and contains 'glauconite' throughout. The upper sequence is laminated to thinly bedded where not bioturbated, and the lower sequence is thinly to thickly bedded. Some beds are calcareous or markedly clayey. The grey mudstone and siltstone are carbonaceous in part and are generally laminated (where not bioturbated). The sequence below 200 feet (60 m) is almost entirely sandstone. The entire sequence is probably of marine origin (see Appendix) with different environments above and below 145 feet (44 m). Marine sedimentation appears to have commenced earlier here than on the Roma Shelf, with marine sediments sitting directly on the Mooga Sandstone.

Dalby No. 3 (Fig. 10) intersected some 200 feet (60 m) of carbonaceous mudstone, siltstone, and sandstone of the Bungil Formation. 'Glauconite' is limited to the upper 140 feet (43 m), suggesting that this could be equivalent to the Minmi Member of the type area, and the lower part to the Nullawurt-Kingull sequence. Sandstones of the upper sequence are more labile than those of the lower sequence. The lower 20 feet (6 m) contain coal and identifiable plant remains, suggesting swampy conditions.

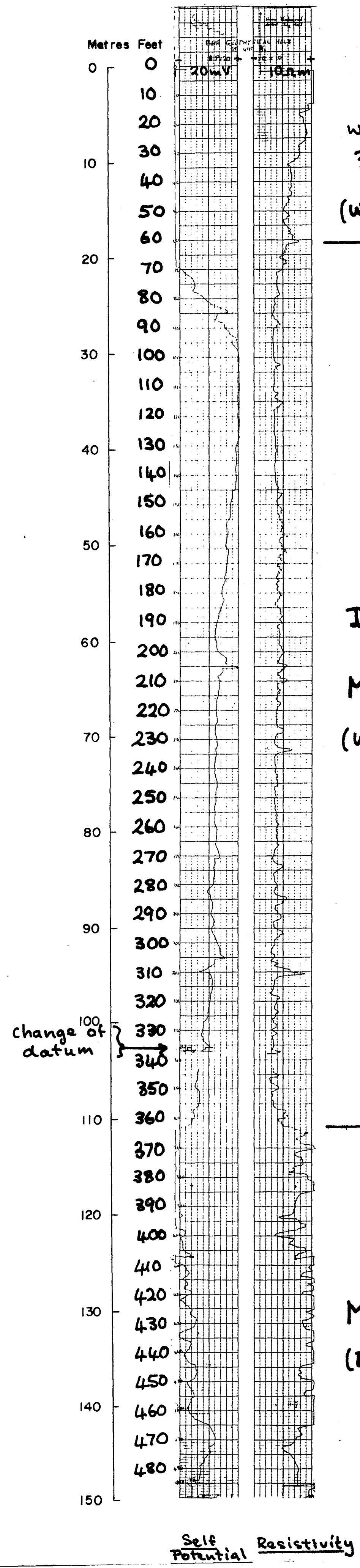
BMR Seismic Shot-hole $499^3/12$ (Fig. 11) contains a lower sequence 125 feet (38 m) thick which the electric log suggests is more sandy than the overlying sequence. This sequence is correlated with the upper part of the Bungil Formation in Roma No. 1 (Fig. 8).

The thickness of the Bungil Formation in the Roma area (Table 6) averages 90 m around the basin margin on the Roma Shelf and in the Mimosa Syncline; farther into the basin it is thicker (about 130 m).

In the three holes where lithological samples were taken, palynological assemblages were obtained. In Roma No. 1 (D. Burger, pers. comm.) sampling was confined to the lower part of the Minmi Member, the Nullawurt Sandstone Member, and the Kingull Member (Fig. 8). All were of K1a (early Cretaceous) age. Dinoflagellates were confined to the Minmi Member, confirming its marine nature and agreeing well with shelly macrofossil data. In Roma No. 8 (D. Burger, pers. comm.), the lower part of the Bungil sequence yielded a probable K1a assemblage, and the upper part a K1b-c (also early Cretaceous) assemblage with some dinoflagellates (Fig. 9). BMR Dalby No. 3 (Kemp, 1972) yielded a K1b-c assemblage from cuttings at 80 to 90 feet (24-27m), and dubious assemblages from the base of the hole, where rare dinoflagellates occur.

BMR SEISMIC SHOT-HOLE 499 3/12.

ROMA SHELF SEISMIC SURVEY
(IN RICHMOND GAS FIELD)



weathered profile
? COREENA MEMBER
(Wallumbilla Fmn)

DONCASTER MEMBER
(Wallumbilla Fmn)

MINMI MEMBER
(Bungil Fmn)

WALLUMBILLA AND BUNGIL FORMATIONS

Hole was drilled and logged in July 1967

To accompany Record 1972/54 G55/A12/20

FIGURE 11

Doncaster Member of the Wallumbilla Formation

The Aptian Doncaster Member was completely penetrated in BMR Seismic Shot-hole 499^3/12 (Fig. 11) and the upper part of it was penetrated in Roma No. 9 (Fig. 12). In the seismic shot-hole, where it is 300 feet (91m) thick, the electric logs show the unit as largely muddy, with a few thin sands.

In Roma No. 9 (Thomas & Reiser, 1968, and Fig. 12) the member is 150 feet (46 m) thick and consists essentially of laminated to thinly bedded grey mudstone and siltstone. The mudstone varies from tough and pale grey to soft, black and very carbonaceous, and grades imperceptibly into fine-grained siltstone. Very fine-grained lithic siltstone is present at some levels, especially towards the base, and pelecypods and dinoflagellates are present in Core 3 (257-263 ft). Burger (1968) has identified a K1b-c assemblage from Core 4 (347-357 ft).

Were it not for the fossil evidence from this hole (see also Coreena Member and Thomas & Reiser, 1968) it would have been possible, lithologically, to consider the upper 60 feet (18m) Coreena Member, the sequence from 60 to 320 feet (18-96m) Doncaster Member, and the sequence below 320 feet (96 m) Minmi Member. The electric logs (Fig. 12) suggest a decrease in siltstone below 210 feet (64 m) but the sensitivity of the instrument was set very high, and the difference may be more apparent than real.

The Doncaster Member was deposited in a shallow marine environment, but generally covered by more than 20 metres of water. Its thickness (Table 6) is about 80 to 100 m on the Roma Shelf and considerably more in the Mimosa Syncline (165 m in AAO Lorelle No. 1). Core analyses (Duff, 1968) showed effective porosities of 21 and 32%, and horizontal permeability of 120 millidarcies in the lower sand.

Coreena Member of the Wallumbilla Formation

The upper 210 feet (64 m) of Roma No. 9 (Fig. 12) was regarded by Thomas & Reiser (1968, p. 24-5) as belonging to the Albian Coreena Member, largely on fossil evidence.

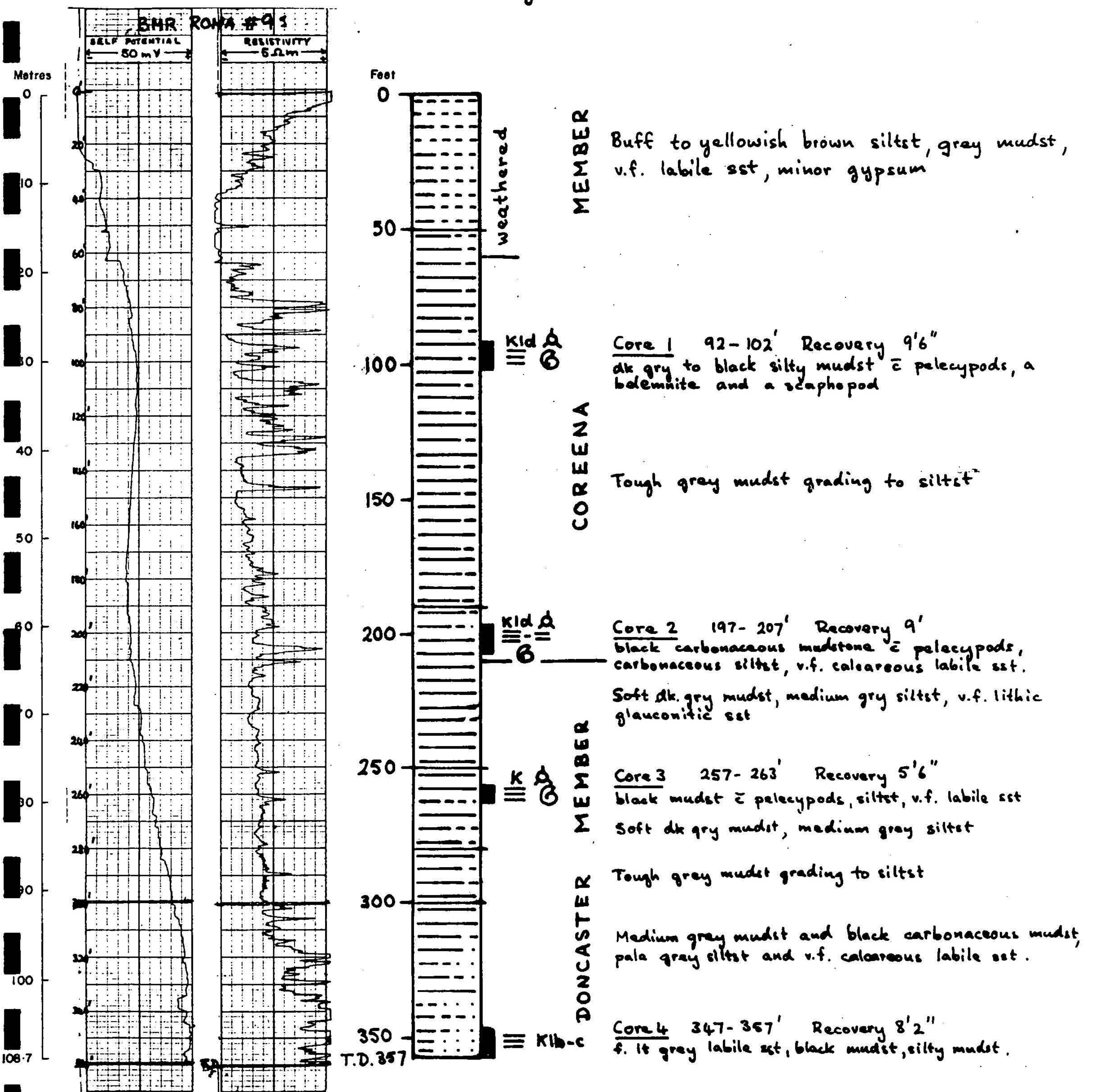
This sequence consists essentially of laminated mudstone and siltstone. These rock types grade imperceptibly into one another and vary from tough and medium grey to soft, carbonaceous, and black. Very fine-grained 'glauconite' labile sandstone is a minor constituent of the sequence.

Both cores (Burger, 1968) contain a K1d spore assemblage, which in the Roma area (Exon, 1971; Table 4) is confined to the Coreena Member and is of Albian age. Dinoflagellates are also present, and from Core 1 (92-102 ft) Terpstra (1968) reported Foraminifera whose age may lie near the Aptian-Albian boundary. Pelecypods are present in both cores, and the belemnite Peratobelus oxys in Core 1. This belemnite, an Aptian form, has been found in the upper Doncaster-middle Coreena sequence, but R.W. Day regarded this specimen as being derived (Thomas & Reiser, 1968, p.34).

DRILL HOLE BMR ROMA NO. 9

WALLUMBILLA FORMATION

Water-drilling below 197 feet



To accompany Record 1972/54

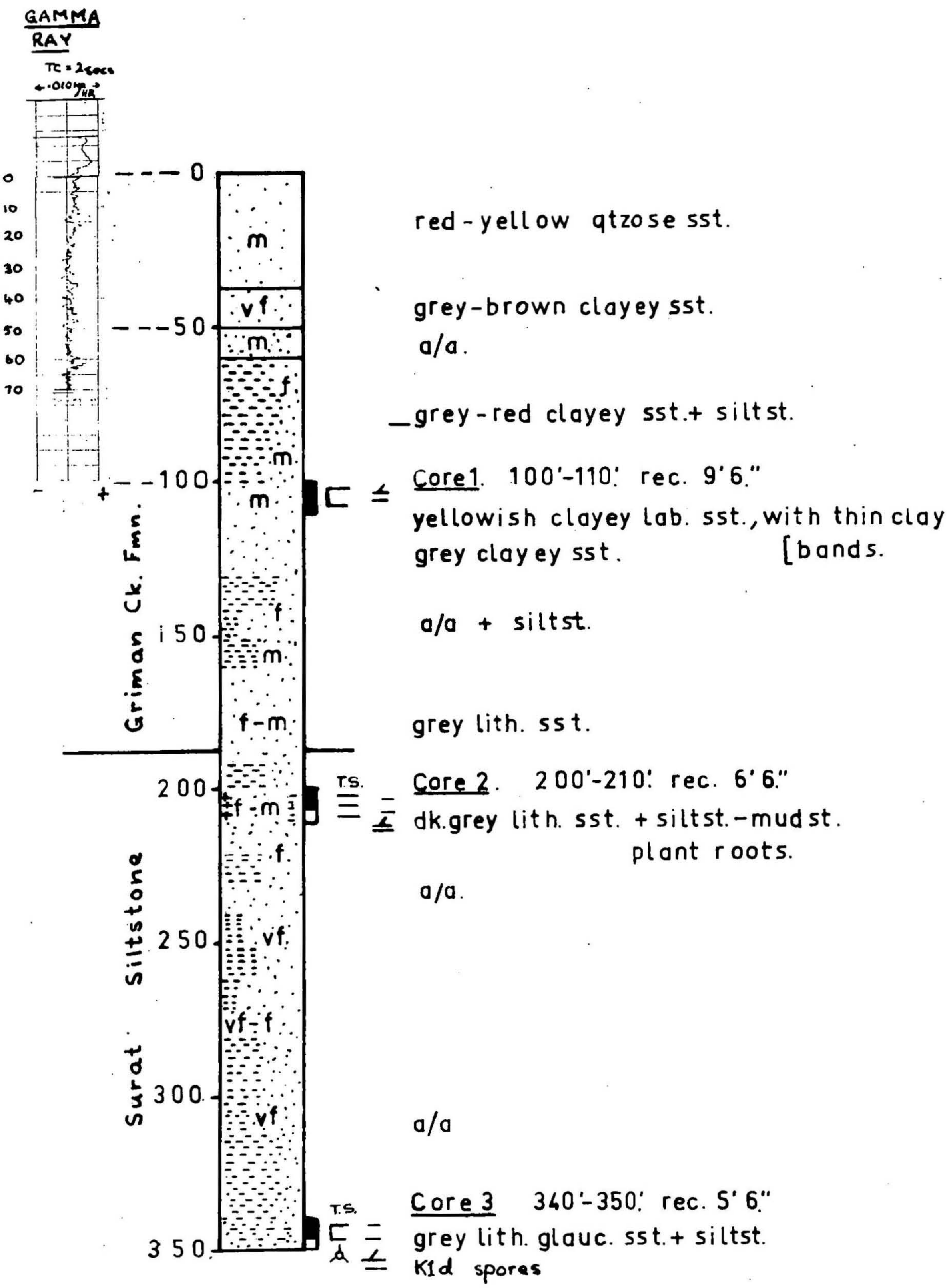
G55/A12/21

FIGURE 12

DRILL HOLE B.M.R. DALBY No. 2.

GRIMAN CREEK FORMATION AND SURAT SILTSTONE

Water-drilling below 80 ft, weathered to 130 ft



Depths in feet

G 56/A13/17 to accompany Record 1972/54

FIG. 13

The lithology suggests deposition in a shallow sea, but it was probably largely covered by 20 metres or more of water in this area. Core analyses (Duff, 1968) gave effective porosities of 21 and 29%.

Thus, in essence, only the palynology provides strong evidence that this sequence is Albian rather than Aptian. Around the basin margin the Doncaster Member has always been regarded as Aptian (e.g. Vine & Day, 1965) and the Coreena Member as Albian (Vine et al., 1967). Thus this sequence is regarded as Coreena Member, although the possibility remains that Doncaster lithologies are extending upward into the Albian away from the basin margin.

Surat Siltstone

The 160 feet (49 m)-thick sequence below 190 feet (58 m) in Dalby No. 2 (Fig. 13) is regarded as being the upper part of the Albian Surat Siltstone. It consists essentially of very fine to fine-grained dark grey lithic sandstone, siltstone, and mudstone. These rock types are laminated to medium-bedded, and interlaminated and interbedded. In hand specimen the sandstone is lithic, greenish grey to dark grey, and glauconitic. It is calcareous in part, and shows some high angled crossbedding. The siltstone and mudstone are dark grey and carbonaceous in part.

Two thin sections of sandstones from the cores (Exon & Smart, 1972) show them to consist essentially of 20% quartz, 5 to 10% feldspar, 20% rock fragments, up to 20% 'glauconite', and 30 to 35% clay matrix. Accessory minerals include biotite, chlorite, and magnetite, and carbonaceous debris makes up around 5% of the rock. Grains are subangular.

Palynological evidence from the lower core (Burger, 1972b) shows that it contains a K1d assemblage and rare dinoflagellates. The formation was deposited largely under shallow marine conditions.

Griman Creek Formation

The upper 190 feet (58 m) of Dalby No. 2 (Fig. 13) is assigned to the Griman Creek Formation. It consists essentially of fine to medium-grained sandstone and lesser siltstone. In the weathering profile, above 130 feet (40 m), the rocks are multicoloured and leached. Where fresh the sandstone is grey and lithic and the siltstone is grey. The sandstone is medium-bedded and cross-bedded. The contact with the Surat Siltstone in this hole is not marked, but is based largely on the change from medium-grained to very fine-grained sandstone, and on the presence of mudstone in the Surat Siltstone.

The formation was deposited in near-shore conditions, both marine and terrestrial.

SYMBOLS USED ON LITHOLOGICAL LOGS

Grain size

Sandstone

vf	very fine	0·06 - 012 mm	
f	fine	0·12 - 0·25 mm	
m	medium	0·25 - 1·0 mm	
c	coarse	1·0 - 2·0 mm	

quartzose sandstone > 90% clasts quartz
sublabile sandstone 75-90% " "
labile sandstone < 75% " "

Siltstone

Mudstone

Mudstone

Coal

Bedding structure

very thick	> 100 cm
thick	30-100 cm
medium	10 - 30 cm
thin	1 - 10 cm
laminated	< 1 cm
crossbedded	
crosslaminated	
bioturbated	

Fossils

Dinoflagellates
Plants
Shelly macrofossils

Cretaceous spore divisions

K
K1a
K1b-c
K1d

Core

recovery
no recovery

( ) surrounding symbol mean weakly developed or rare.

To accompany Record 1972/54

FIGURE 14

M(C) 34

Table 7 - Abbreviations used on lithological logs

a/a	=	as above
brn	=	brown
c	=	coarse
$\bar{c}$	=	with
Carb	=	carbonaceous
dk	=	dark
f	=	fine
fe	=	iron
feld	=	feldspathic
frags	=	fragments
glauc	=	'glauconite'
gry	=	grey
l	=	light
lab	=	labile
lith	=	lithic
lge	=	large
m	=	medium
mudst	=	mudstone
rec	=	recovery
si	=	silicified
siltst	=	siltstone
sl	=	slightly
sublab	=	sublabile
sst	=	sandstone
T.S.	=	thin section
v.	=	very
v.f.	=	very fine
v.c.	=	very coarse

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APPENDIX

PETROGRAPHY OF BMR ROMA NO.8 - BUNGIL FORMATION

Eleven thin sections from cores ranging in depth from 52 feet (16 m) to 264 feet (80 m) were examined petrographically, and estimates of proportions of constituents were made without the aid of point counting. The results are summarized in Table 8.

The hole spudded in Quaternary alluvium, and the uppermost Cretaceous sediments probably immediately underlie the Doncaster Member of the Wallumbilla Formation. The total thickness of the Bungil Formation in the adjacent GSQ Roma No. 3 is 93 m, compared to the 81 m penetrated here; thus probably only the lower 10% of the formation was not penetrated in BMR Roma No. 8.

The members of the Bungil Formation in the Roma area cannot be identified in the well log (Fig. 9). The formation (Fig. 9) can be subdivided into an upper bioturbated sequence (Sequence A) with marine macro- and micro-fossils and a probable K1b-c spore assemblage, and a lower well bedded sequence (Sequence B) without marine fossils (at least at the levels cored) and containing a possible K1a spore assemblage. The boundary between the two sequences is at about 145 feet (44 m).

By comparison with BMR Roma No. 1 (Fig. 8) the upper sequence could be equated to the Minmi Member and the lower sequence to the Nullawurt Sandstone plus Kingull Member. The bedding, the marine fossils, and perhaps the spores, support this correlation.

Thin-section studies (Table 8) show that there are only minor changes in the mineralogy of the sediments throughout the sequence. The sandstone consist of dominant quartz, abundant feldspar (largely weathered K-feldspar, with lesser plagioclase), considerable rock fragments (largely chert of unknown affinities, with some volcanic and metamorphic grains) and several green minerals ('glauconite')in a clayey matrix or calcareous cement. Common accessory grains include muscovite, biotite,zircon, and carbonaceous debris. The 'glauconite' varies from well rounded, medium green grains with a granular internal structure to intergranular crystalline chlorites. X-ray diffraction studies of the clay fraction of samples from 53'10" and 264'5" show the dominant phyllosilicate to be montmorillonite; no true glauconite is discernible. The diffractograms are similar to each other. In the literature the field term 'glauconite' has frequently been shown to apply to phyllosilicates which are not true glauconite (e.g. Lange & Sarnthein, 1970), but these minerals can perhaps be regarded as predecessors of true glauconite, and their environmental significance may be the same.

Some differences are discernible between Sequence A (above 145 feet) and Sequence B (below 145 feet). In Sequence A the effects of bioturbation are very apparent in the lack of bedding and the mixed sand-mud sediments, and carbonaceous debris does not exceed 1% of the rock. In Sequence B bedding is apparent, and carbonaceous debris makes up to 10% of the rock. However in both sequences the appearance and amount of the 'glauconite' is comparable.

Sequence A, with its marine organisms and bioturbation, is obviously marine, and almost certainly shallow marine. It contains rounded green grains consisting of clay minerals and loosely termed 'glauconite', which are identical to those found throughout the marine Cretaceous sequence in Queensland.

Sequence B lacks marine organisms, is thinly well bedded and contains carbonaceous plant debris. As it contains identical 'glauconite' to that in the overlying marine sequence, it is suggested that it too was, at least partly, marine. The chances of forming the same round green clay-mineral grains in fresh water, as well as in marine deposits, appears remote. Sequence B is probably a transitional sequence (non-marine Mooga Sandstone giving way to marine Sequence A). It could also conceivably be a deeper-water deposit than Sequence A, in which case one would have to envisage a rapid marine transgression followed by a shallowing of water as sediment accumulated.

If the correlation with the Roma area is accepted (Sequence A = Minmi Member, Sequence B = Nullawurt Sandstone + Kingull Member), marine conditions developed earlier in the Mimosa Syncline than on the Roma Shelf, where the lower sequence was apparently laid down in fresh water. A similar situation is recorded in the Merivale Syncline on the other side of the Roma Shelf, where marine pelecypods are found in the Nullawurt Sandstone Member (Exon, Milligan, Casey, & Galloway, 1967; Day, 1967).

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Table 8 - Sandstone Mineralogy, Roma No. 8 in Bungil Formation.

Depth (feet)	Grainsize of sand bodies (mm)	Quartz	Feldspar	Rock Fragments	'Glauconite'	Mica	Other Constituents	Matrix and Cement	Roundness and sorting	Classification (hand specimen)
52'4"	0.1 - 1	30%	20% K > plag	10% "chert", volcanics	20-30%	minor muscovite	1% carbonaceous fragments	15% clay	angular-subrounded, poor sorting	Bioturbated glauconitic sandstone and mudstone
53'10"	0.1 - 0.3	40-55%	10-15% K = plag	5% "chert", minor volcanics	10-30%*	1% muscovite> biotite	1% carbonaceous	15% clay	angular-subrounded, poor sorting	Bioturbated glauconitic sandstone
100'11"	0.2 - 0.4	30%	10% K > plag	5% "chert", volcanics	5%	minor muscovite	minor carbonaceous fragments	50% clay	angular-subrounded, very poor sorting	Bioturbated clayey glauconitic sandstone and mudstone
104'3"	0.2 - 0.4	50%	20% K > plag	5% "chert"	10%	minor muscovite	1% carbonaceous fragments, zircon	15% clay, chloritic	subangular-subrounded, moderate sorting	Slightly bioturbated glauconitic sandstone and mudstone
152'10"	0.1	40%	15% K > plag	5% "chert"	5%	1% muscovite, biotite	1% carbonaceous fragments, zircon	35% clay	angular, moderate sorting	Interlaminated clayey glauconitic sandstone and mudstone
156'1"	0.1 - 0.3	35%	20% K >plag	5% "chert", volcanics	10%	2% muscovite> biotite	2% carbonaceous fragments, zircon	25% clay	angular-subangular, moderate sorting	Interlaminated glauconitic sandstone and carbonaceous siltstone
213'2"	0.1 - 0.2	50%	15% K > plag	5% "chert"	10%	1% muscovite> biotite	5% carbonaceous fragments	20% clay, chloritic matrix. 15% calcite	angular, moderate sorting	Interlaminated calcareous glauconitic sandstone and siltstone
214'5"	0.1 - 0.3	40%	10% K > plag	5% "chert", volcanics, quartzite	minor	1% muscovite, biotite	5% carbonaceous fragments, minor zircon, magnetite	10% clay matrix. 30% calcite	angular-subrounded, moderate sorting	Thinly bedded calcareous sandstone
257'6"	0.1 - 0.3	50%	20% K > plag	5% "chert"	10%	1% muscovite, biotite	2% carbonaceous fragments	10% clay	angular, poor sorting	Porous glauconitic sandstone
259'2"	0.1 - 0.2	30%	15% K >plag	5% "chert"	15%	1% muscovite, biotite	10% carbonaceous fragments and shreds, minor zircon	25% clay, chloritic	angular-subrounded, moderate sorting	Thinly bedded glauconitic sandstone and siltstone
264'5"	0.1 - 0.2	45%	15% K > plag	5% "chert"	10%*	minor muscovite, biotite	2% carbonaceous fragments	25% clay, chloritic	angular, well sorted	Porous glauconitic sandstone

* 'Glauconite' is largely montmorillonite on X-ray diffraction evidence.