COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1970 / 46

Stratigraphic Drilling in the Ngalia Basin,

Northern Territory 1968 – 1969

by

T.G. Evans and T. Nicholas

STRATIGRAPHIC DRILLING IN THE NGALIA BASIN NORTHERN TERRITORY

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Contents

SUMMARY

Shallow stratigraphic drilling in the Ngalia Basin was carried out in 1968 and 1969. The programme was designed to supplement surface mapping and to assist in the interpretation of seismic record sections. A total footage of 1657 feet (505 metres) was drilled in 1968 and 4,766 feet 6 inches (1452.83 metres) was drilled in 1969. Drilling objectives were achieved in 7 of the 11 holes drilled on the Mount Doreen Sheet area in 1969 and in only one of four holes drilled on the Napperby Sheet area in 1968.

INTRODUCTION

Geological reconnaissance mapping and seismic surveys in the Ngalia Basin were carried out in 1967 and 1968 by the Bureau of Mineral Resources. As a result of these surveys it was found that because of poor exposure of formations and discontinuity of seismic record sections there was little correlation possible between the known geological succession and the seismic reflection records. In addition the extent of the Lower Palaeozoic sediments in the Basin was not known. A programme of shallow stratigraphic drilling was drawn up with the aim of solving these problems.

In August 1968 four B.M.R. stratigraphic boreholes were drilled on the Napperby Sheet area by the Petroleum Technology Section, Mineral Resources Branch. Intairdrill Aust., a private drilling contractor, drilled eight shallow stratigraphic boreholes for the Bureau of Mineral Resources from the 20th July to 20th September 1969. The results of this drilling are the subject of this record. The well site geologists were T.G. Evans and T. Nicholas.

Ditch cuttings were collected over each 5 foot interval and described. Two representative samples of each interval were washed and retained in plastic bags. One set of samples is stored in the Core and Cuttings Laboratory of the Bureau of Mineral Resources at Fyshwick Canberra, the second set is stored at the offices of the Resident Geologist, N.T.A., Alice Springs. It was expected that two cores would be cut in each hole with a minimum acceptable diameter of NX ($2\frac{3}{8}$") and a preferred core length of 10 feet. The main purpose of the coring was to obtain a sample of the pre-Tertiary country rocks.

All holes drilled in 1969 were logged for S.P., Resistivity and Gamma Ray using a Widco 2000 Logging Unit. This was operated by the Wellsite Geologist and successful logs were obtained in most holes. Figure 1 shows the localities of the holes drilled.

The Ngalia Basin is at present held as a Petroleum Title (Oil Permit 165 Petroleum Ordinance of the Northern Territory) by Magellan Petroleum Australia Ltd. and Southern Pacific Petroleum No Liability.

The regional geology of the Mount Doreen Sheet area has been described by Wells, Evans and Nicholas (1968, unpubl.) and of the Napperby Sheet area by Evans and Glikson (1969, unpubl.).

DRILLING DATA: MOUNT DOREEN SHEET AREA, 1969

DRILLING BY:	Intairdrill Aust. Pty. Ltd. P.O. Box 133 APPLECROSS, W.A. 6153
DRILLING PLANT:	
MAKE	Gardner Denver
TYPE	15W
RATED CAPACITY	1500 feet with 4½ inch drill pipe/tubing
ENGINES	G.M.C. 8V-71 and 4-71
MAST:	
MAKE	Gardner Denver
TYPE	36" x 26" x 50'
RATED CAPACITY	60,000 lbs.
WORKING HEIGHT	50 feet.
ROTARY TABLE:	
MAKE	Gardner Denver
SIZE	7½ inch Retractable to allow for up to 16" casing.
PUMPS:	
MAKE	Gardner Denver
TYPE	FG - F x G
SIZE	5" x 6"
COMPRESSORS	
NUMBER	2
MAKE	Gardner Denver
TYPE	WEK
Cubic feet/min	660 and 440
PRESSURE	250 Psi
AIR HAMMER	
MAKE	Mission
TYPE	4220 and 5120
SIZE	4¼" and 5¼"
HOLE SIZE RANGE	4¾" to 6¾"

Rig is equiped with Bean Pump for foam injection.

CEMENTING EQUIPMENT

Rig Pump used in cementing

DEVIATION SURVEY EQUIPMENT

MAKE	SURESHOT
TYPE	A
O.D.	$1\frac{3}{8}$"
RUNNING METHOD	Wireline

CUTTINGS REMOVER AND SAMPLE COLLECTION

Cyclone Blower

CASING

SIZE (O.D.)	6" x 3/16" Wall
GRADE	Waterbore
WEIGHT	12 lbs/ft
MAKE	

PERSONNEL AND ADMINISTRATIVE

SHIFTS RUN

DAILY	2 maximum
WEEKLY	7
HOURS PER SHIFT	12
DRILLERS	W. Withers T. Vidler
DRILLING SUPERVISORS	E.F. Haynes R.W. Reed

B.M.R. MOUNT DOREEN NO. 7.

POSITION

Mount Doreen, Grid Reference 415.6, 229.5*. At the north end of B.M.R. Seismic line A, near S.P. 1624. 3.2 kilometres north of Davis Gap. Drilling commenced in superficial Cainozoic sediments. Ground level 603 metres (1979 feet).

OBJECTIVES

(a) To determine what formation is present beneath the Cainozoic sediment over.

(b) By inference determine the age of the dolomite which crops out 1.2 kilometres to the south.

DRILLING

Easy drilling was encountered from surface to 330 feet. A hammer bit was used from 330 feet to T.D. at 375 feet.

Salt water was struck at 190 feet. One core was cut from 202 to 212 feet with poor recovery; 1 foot of fragmentary green argillite was obtained. The bore was plugged with wood and abandoned.

RESULTS

0 to 202' Siltstone medium yellow-brown, soft.

202' to 375' Argillite medium greenish-grey, very fine grained, chloritic.

Brief field checks of nearby outcrops proved that the dolomite belongs to the Mount Doreen Formation. The drill hole cuttings and core are correlated with the green siltstone occurring in the basal part of the Mount Doreen Formation.

* Grid references refer to 10,000 yd grid.

B.M.R. MOUNT DOREEN NO. 8.

POSITION

Mount Doreen Grid Reference 414.0, 178.4. At the southern end of B.M.R. Seismic line A near S.P. 1539. Ground level 568 metres (1867 feet). Drilling commenced in superficial Cainozoic deposits.

OBJECTIVES

To identify a seismic reflector of intermediate depth which projects to the surface near this point.

DRILLING

Drilling in Cainozoic sediments reached 135 feet and at this depth a cobble bed with abundant water caused the hole to be abandoned. A second attempt to drill the hole was abandoned at 235 feet due to drilling problems associated with excessive water in the hole.

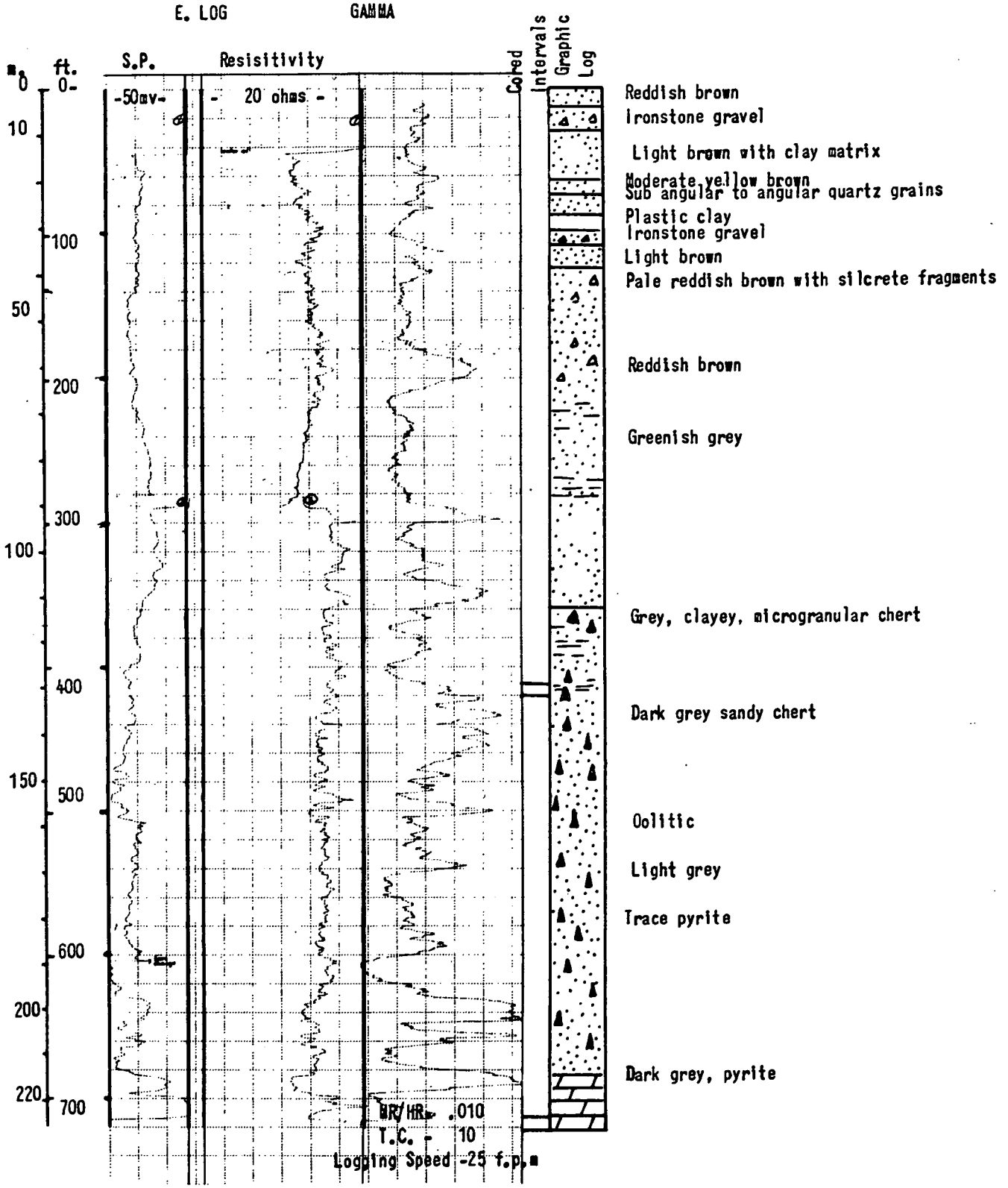
The water was analysed and found to be unsuitable for human consumption due to an excess sulphate content (Table 1).

RESULTS

In both attempts the drill penetrated Cainozoic unconsolidated silty sand and gravel with a coarse cobble bed occurring at 135 feet. This bed proved to be an excellent aquifer with an estimated flow of 30,000 g.p.h. (drillers estimate) being air lifted. At S.P. 1540, 549 metres (1800 feet) away, this aquifer was not encountered.

B.M.R. MOUNT DOREEN BOREHOLE No. 8B

Fig. 2



B.M.R. MOUNT DOREEN NO. 8B.

POSITION

Mount Doreen, Grid Reference 414.0, 179.6. About 549 (1800 feet) north of Mount Doreen No. 8 on B.M.R. Seismic line A. Near S.P. 1540. Ground level 571 metres (1872 feet).

OBJECTIVE

As at Mount Doreen No. 8 to identify a seismic reflector believed to project to the surface close to this point.

DRILLING

A total of 717'6 was drilled with two intervals cored. Core 1 cut 10 feet from 410 to 420 feet. Recovery was poor and only 6 inches of pale buff, grey clay with chert fragments was recovered. The bottom hole core of 7 foot 6 inches was cut from 710 feet to 717 feet 6 inches with a recovery of 4 feet. This consists of dark grey, slightly pyritic laminated dolomite. A water sample as collected and analysed (Table 1). The water is unsuitable for human consumption due to excess dissolved salts. The hole was plugged with wood and abandoned.

RESULTS

0-360' Cainozoic sands and clays.
360'-717'6" Sand, light grey porcellanitic sand, oolitic, pyritic chert, dark grey dolomite.

No obvious correlation is possible; however the occurrence of dolomite in the borehole suggests that the cuttings can be correlated with one of the two formations which contain beds of dolomite. These two formations are the Cambrian Walbiri Dolomite and the Adelaidean Mount Doreen Formation. The lithology is not typical of either formation but a correlation with the Mount Doreen Formation is favoured. The dolomite may correspond with the seismic reflector which was the drilling target.

B.M.R. MOUNT DOREEN NO. 9.

POSITION

Mount Doreen Grid Reference. 351176. At the southern end of B.M.R. Seismic traverse J near S.P. 3485. Ground level 524 metres (1720 feet). Drilling started in superficial Cainozoic deposits.

OBJECTIVES

To identify a seismic reflector of intermediate depth which projects to the surface near this point.

DRILLING

The borehole was drilled to a total depth of 800 feet and it was cased to 343 feet. Water was encountered at 55 feet. Analysis (Table 1) showed it to be chemically suitable for human consumption. Two intervals were cored. Core 1 cut from 670 (204·2 m) to 676'6" had a recovery 98% of dark reddish brown to purplish yellow micaceous siltstone. Core 2, the bottom hole core, was cut from 792' to 800' with 100% recovery of brecciated slumped dolomitic siltstone. 114 feet of casing was left in the hole.

RESULTS

0 - 135' Cainozoic sand and silcrete.

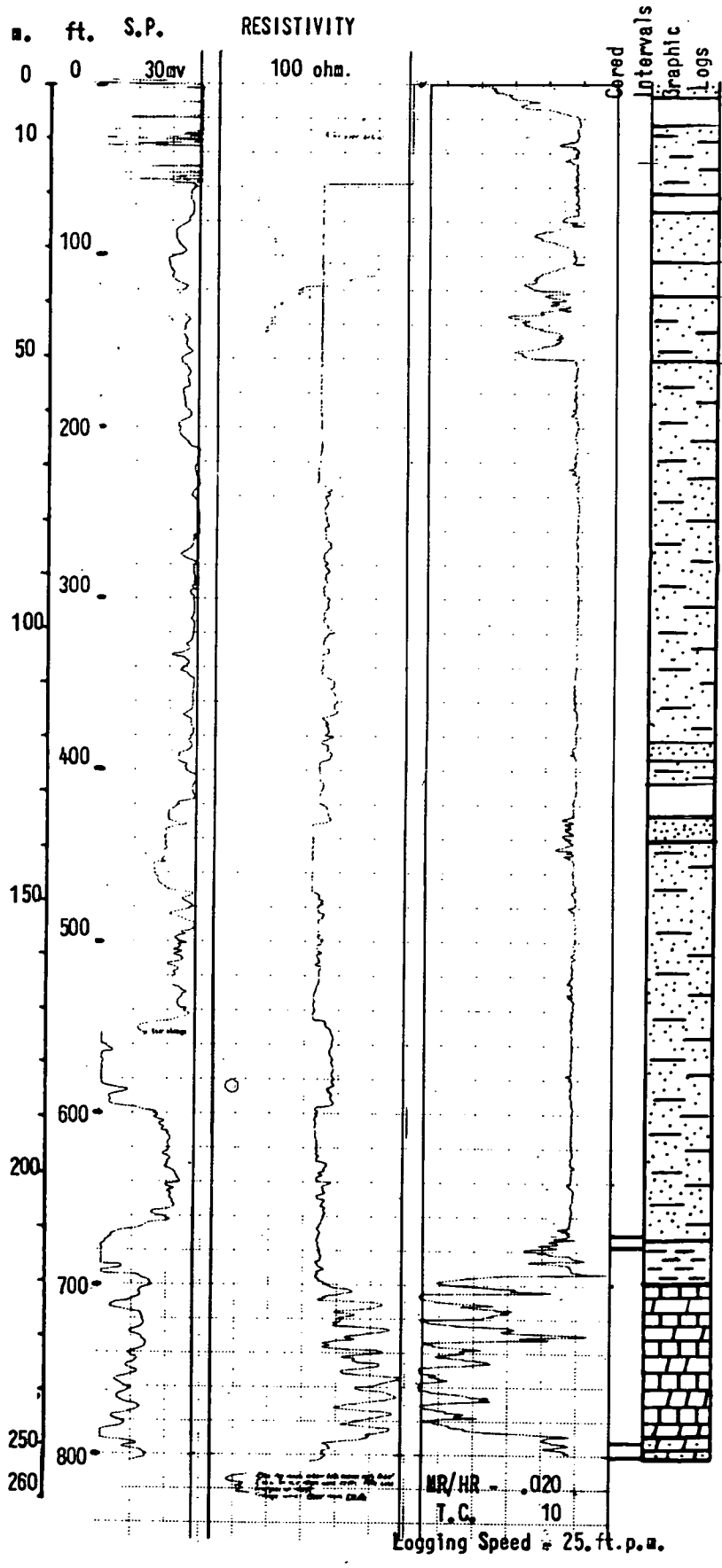
135' - 695' Sand, purple, friable , fine to medium, micaceous, silty. (Core 1)

695' - 792' Dolomite limestone with red-brown silt interbeds.

792 - 800' Siltstone, slumped, brecciated, red-brown dolomitic, interbedded with sandstone coarse to fine, weakly cemented.

The drilling target, the seismic reflector, is believed to be the dolomite bed encountered at 695 feet. Two formations that contain dolomite are known to crop out in the Ngalia Basin. One is a dolomite bed within the Mount Doreen Formation of Adelaidean age, the other is the Cambrian Walbiri Dolomite. Lithologically the drill hole cuttings more closely resemble the sequence found in the Mount Doreen Formation.

Fig. 3



Reddish brown, unconsolidated
Travertine

Light to moderate brown
Minor Gypsum
Czy

Silcrete, ironstone fragments
Light brown, angular

Yellow brown, silcrete — 38
Czi

Greenish grey, soft
Czk

50

Purple some thin sandstone beds with chlorite.
mi

White, sub angular, soft
Purple micaceous & chloritic
No cuttings
Mi, rounded

Ce in database 24/10/96
(? Early Tabor Bay)
• chlorite = glauconite

Red, angular, mottled green

mi Dusky purple, sub angular
Trace marcasite

• purple

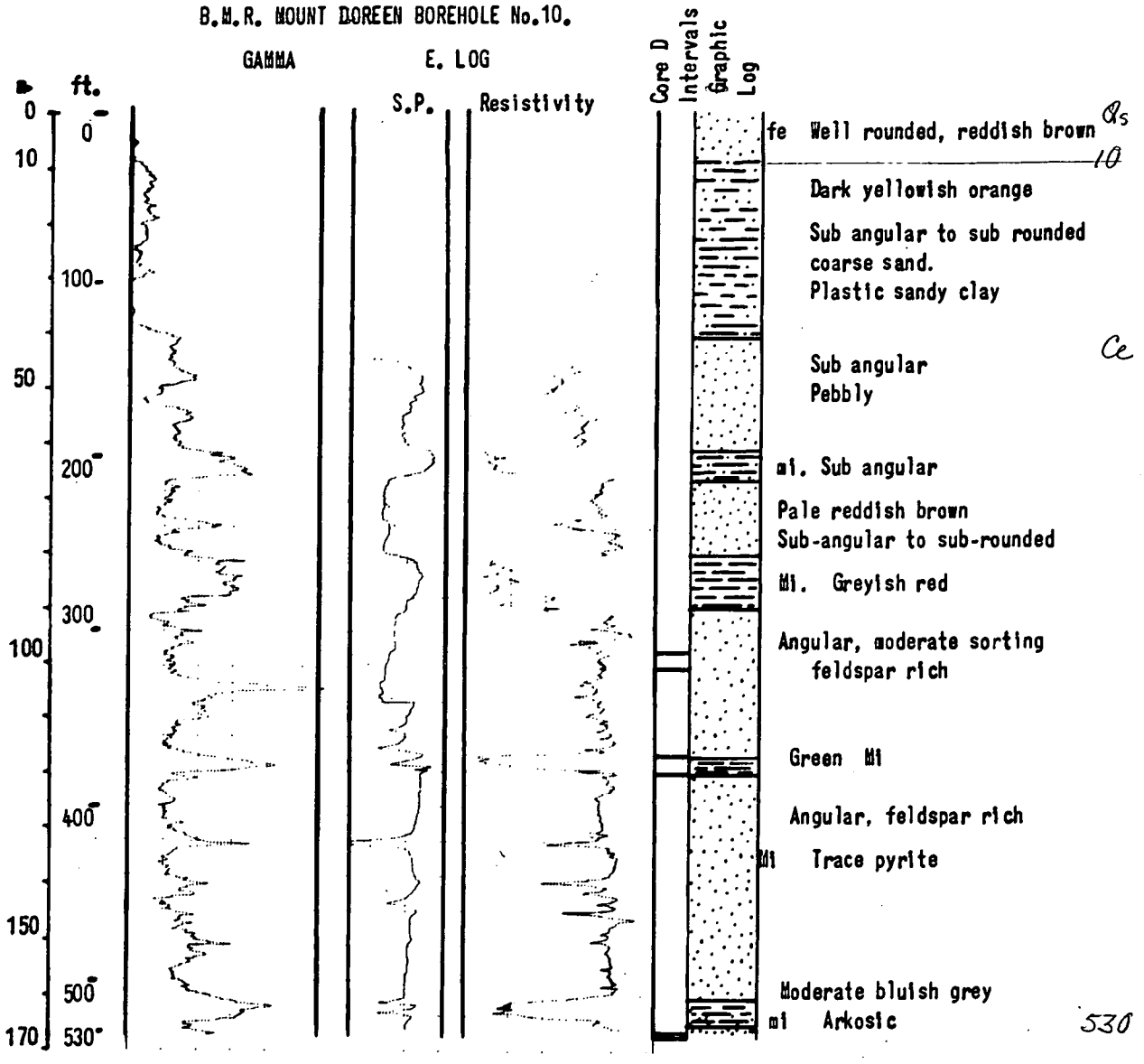
Reddish brown

,Yellow, light grey, stylolitic

Light grey, pale pink — 221

Slumped, brecciated

Fig. 4


B.M.R. MOUNT DOREEN BOREHOLE No.10.
GAMMA
E. LOG
S.P.
Resistivity
Core D
Intervals
Graphic
Log
ft.
0
10
50
100
150
170
0
100
200
300
400
500
530
fe Well rounded, reddish brown
Qs
10
Dark yellowish orange
Sub angular to sub rounded
coarse sand.
Plastic sandy clay
Ce
Sub angular
Pebbly
mi. Sub angular
Pale reddish brown
Sub-angular to sub-rounded
Mi. Greyish red
Angular, moderate sorting
feldspar rich
Green Mi
Angular, feldspar rich
Mi Trace pyrite
Moderate bluish grey
mi Arkosic
530

B.M.R. MOUNT DOREEN NO. 10.

POSITION

Mount Doreen, Grid Reference 451.4, 193.7. 2.4 kilometres west of G.A.I. seismic traverse line 6. Drilling commenced in superficial Cainozoic deposits.

OBJECTIVES

(a) To determine whether Palaeozoic rocks occur close to the surface.

(b) To determine the reason for the prominent aeromagnetic high.

DRILLING

The hole was cased to 145 feet and the casing was left in the hole. Total depth was 530 feet. Three cores were cut. Core 1 was cut from 310' to 320' with 90% recovery of poorly sorted arkose. Core 2 was cut from 370' to 380' with 87% recovery of pale greenish grey carbonaceous siltstone. Core 3 was cut 528 to 530 feet with 100% recovery of feldspathic quartz sandstone. The groundwater encountered in the hole proved to be unsuitable for human consumption due to excess fluoride (Table 1). The hole was plugged with wood and abandoned.

RESULTS

0 - 530' Sandstone, coarse grained, arkosic with interbeds of light greenish grey laminated micaceous siltstone.

The sequence is believed to belong to the Mount Eclipse Sandstone.

This section examination suggests that the sediments are derived from a nearby source area; the occurrence of garnet together with fresh feldspar, quartz and mica may indicate a source area of metamorphic rocks. The micaceous siltstone interbeds commonly have carbonaceous material and pyrite deposited as thin laminae. Spores have been recovered from the carbonaceous material, and these suggest a Palaeozoic age for the formation. The electric and gamma-ray logs show good correlation with the lithological log.

B.M.R. MOUNT DOREEN NO. 11.

POSITION

Mount Doreen, Grid Reference 472.8, 172.5. 2.4 kilometres southwest of an outcrop of Vaughan Springs Quartzite.

OBJECTIVES

To determine what formation is present beneath the superficial Cainozoic sand cover.

DRILLING

The hole was drilled to a total depth of 590 feet and cased to a depth of 193 feet. Water obtained, from the bore is suitable for consumption by adults (Table 1).

Core 1, cut from 480' (146.3 m) to 490 feet (149.35 m), had 90% recovery of green waxy gypsiferous clay.

Core 2, the bottom hole core, had no recovery.

The hole was plugged and abandoned.

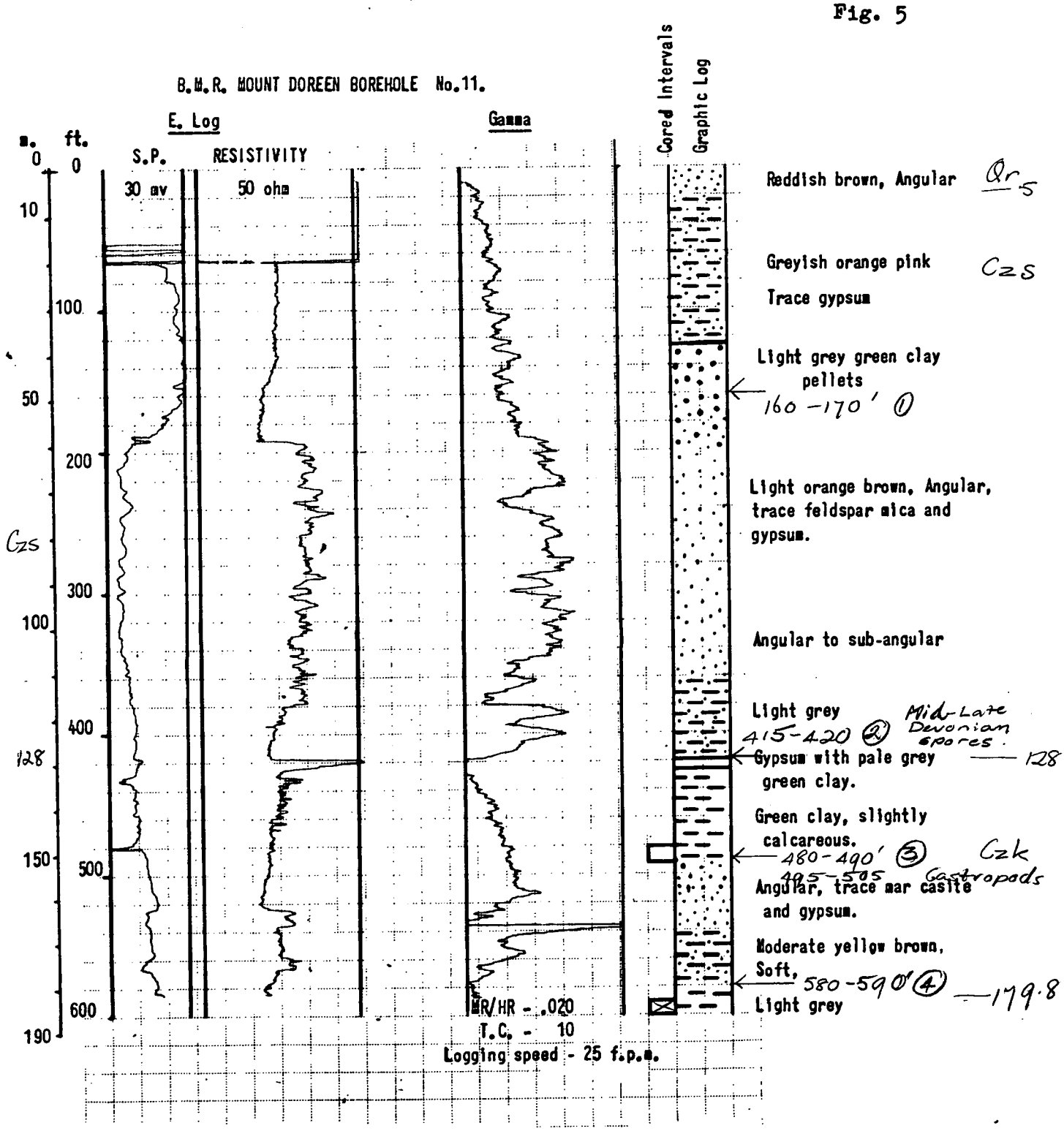
RESULTS

0 - 370' (112.7 m) Quartz grains, light brown to pale grey, orange-pink, coarse subangular with soft clay matrix. Accessory gypsum, mica and feldspar.

370' - 590 (112.7 m - 179.8 m) Clay, green, calcareous, with abundant gypsum, and minor sandy intervals.

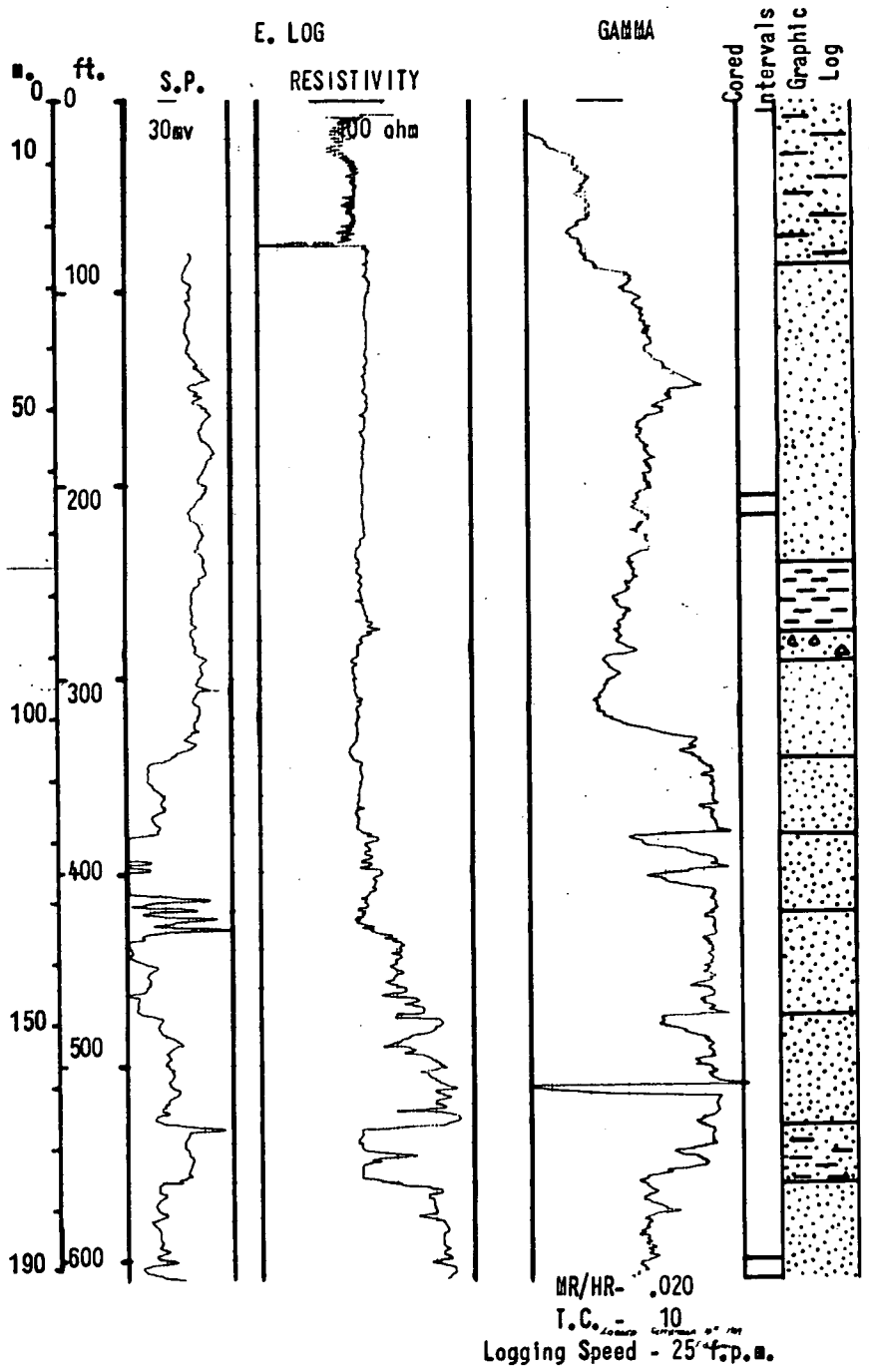
The sequence is thought to be entirely Cainozoic in age. The drilling objective was not achieved. The green clay has been identified by X-ray diffraction. It belongs to the montmorillonite group, and is possibly beidellite.

Fig. 5



120-125m Green clay matrix in clayey sand
BMR 15 to NW
just above bleached VSQ basement
130m

B.M.R MOUNT DOREEN BOREHOLE No.12. (RN 6717) Fig. 6



Moderate reddish brown

Dark reddish brown

Sub rounded to rounded

Fe Friable

Czy

76

Yellowish grey

CzK

Slightly sandy

89 Czi

Silcrete frags. case hardened pellets

92

Red brown sub angular to sub rounded. Silt matrix

mi

Ce

Light brownish grey, clean. Sub angular to angular. Friable

Trace pyrite

Trace pyrite

Sub rounded to sub angular

Arkosic

Sub angular to angular

Pebbly

—185 TD

B.M.R. MOUNT DOREEN NO. 12

POSITION

Mount Doreen Grid Reference. 485.1, 190.1. 1.6 kilometres south of an outcrop of Ordovician (?) Kerridy Sandstone. Drilling commenced in superficial Cainozoic sediments.

OBJECTIVES

To determine what formation is present beneath the cover of Cainozoic sediments.

DRILLING

The hole was drilled to a total depth of 610 feet with two intervals cored. Core 1 was cut from 205' to 215' feet with 75% recovery of friable poorly cemented sandstone.
Core 2 was cut from 600' to 610 feet with 75% recovery of poorly sorted arkosic greywacke. Water was struck at 76 feet and proved to be unsuitable for human consumption due to excess sulphate (Table 1).

RESULTS

0 - 295' Sand, unconsolidated, and porous, light reddish-brown sandstone. C2

295' - 395' Sandstone, silty, red, micaceous.

395' - 415' Quartz sandstone, porous, friable, clean, fine grained.

415' - 610' Greywacke, coarse, pebbly, arkosic.
185

Correlation of the sequence with exposed formations is difficult. The top 295 feet is believed to be of Cainozoic age. The lowest 195 feet is a coarse, pebbly arkosic greywacke, and a thin section study shows a small percentage of garnet. It resembles closely the core and cuttings identified as belonging to the Mount Eclipse Sandstone in B.M.R. Mount Doreen No. 10. However the electric and gamma-ray logs do not suggest such a correlation whilst the interval between 295' and 415' is not correlatable with any known interval within the Mount Eclipse Sandstone.

B.M.R. MOUNT DOREEN NO. 13.

POSITION

Mount Doreen, Grid Reference 509.3, 209.5. 2.4 kilometres south of Mount Allan.

Drilling commenced in superficial Cainozoic sediments.

OBJECTIVES

(a) To determine what formation lies between the Adelaidean Vaughan Springs Quartzite and the Ordovician (?) Kerridy Sandstone.

(b) The results would be used to identify seismic events on B.M.R. seismic traverse L.

DRILLING

The hole was drilled to a total depth of 594 feet. Two cores were cut. Core 1 was cut in the interval 400 to 410' with 15% recovery of fine grained quartz sandstone. Core 2 was cut in the interval 590 to 594' with 70% recovery of fine grained quartz sandstone. Water was struck at 116 feet and proved unsuitable for human consumption due to excessive amounts of dissolved salts (Table 1).

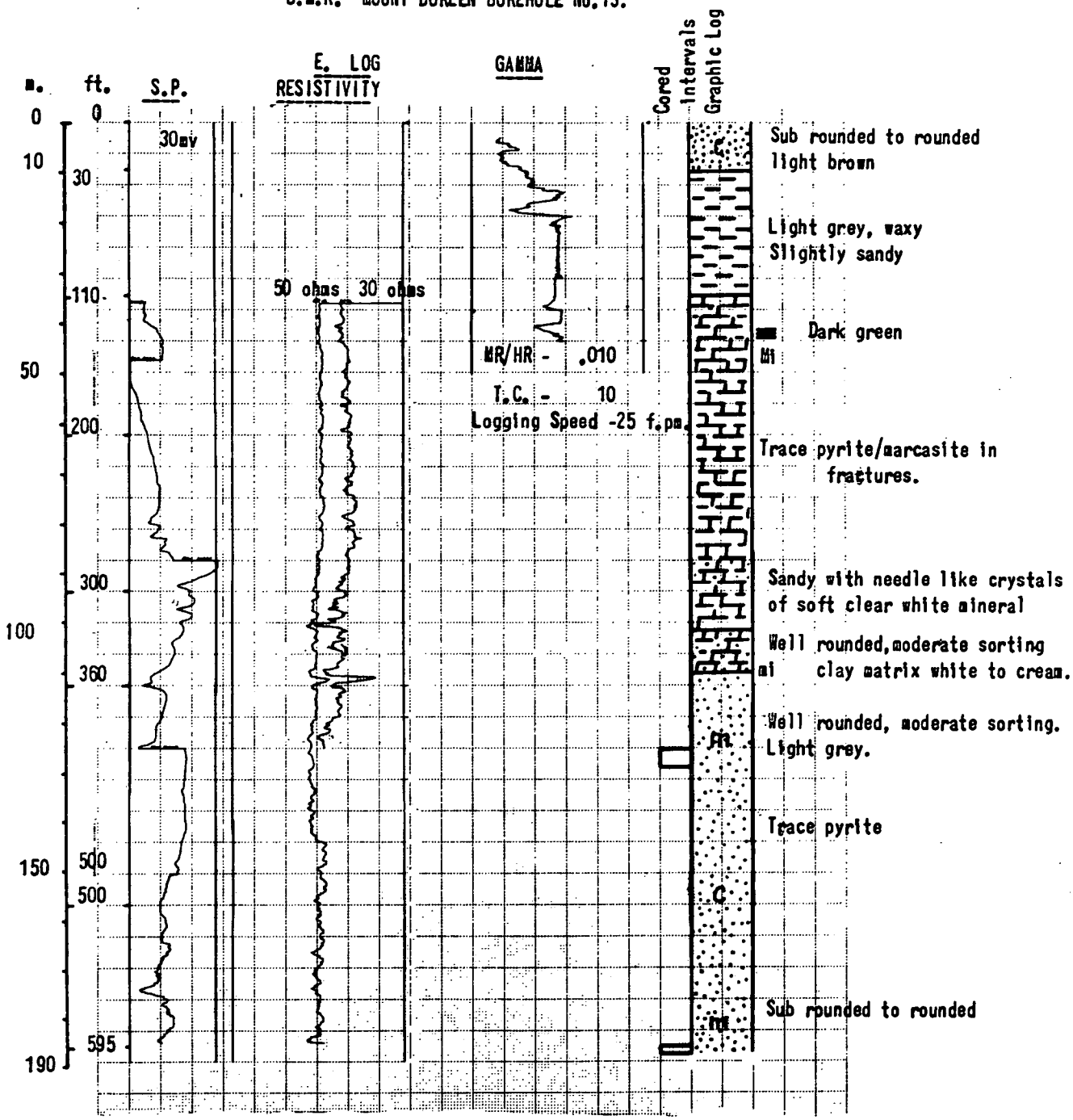
RESULTS

0 - 110' Unconsolidated sand and clay.
110' - 360' Siltstone, dark to light grey, laminated, dolomitic.
360' - 594' Sandstone, fine grained, light grey.

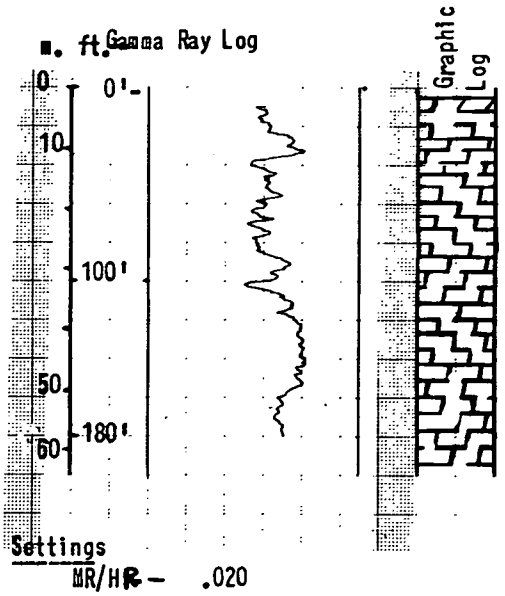
A suggested correlation places the dolomitic siltstone within the Walbiri Dolomite and the fine grained, very well rounded quartz sandstone in the Yuendumu Sandstone. However the dolomitic siltstone could possibly be a Tertiary deposit and the underlying sandstone belong to the Djagamara Formation.

Fig. 7

B.M.R. MOUNT DOREEN BOREHOLE No.13.



B.M.R. MOUNT DOREEN BOREHOLE No.14. Fig. 8



Settings
MR/HR - .020
Time Constant - 10.
Logging Speed - 25 feet per minute

B.M.R. MOUNT DOREEN NO. 14.

POSITION

Mount Doreen, Grid Reference 484.1, 218.5. 0.8 kilometres north of White Point Bore, 6.4 kilometres southwest of Yuendumu Native Settlement. Drilling commenced in the Walbiri Dolomite.

OBJECTIVES

To core a fossil horizon within the Walbiri Dolomite. The fossil horizon is known in nearby outcrops but is poorly exposed.

DRILLING

Very hard drilling was encountered from surface to total depth of 180 feet. A small supply of water was encountered at 180 feet. The first core was cut in the interval 55 feet to 57'6 inches with 80% recovery. The Bottom hole core was cut in the interval 180 to 180' 7½" with 4 inches recovery.

RESULTS

0 - 180 feet. Red-brown, tough, dolomitic siltstone of the Walbiri Dolomite.

The fossil horizon was not intersected, probably as a result of inadequate knowledge of the structural geology of the area.

DRILLING DATA: NAPPERBY SHEET AREA, 1968

DRILLING BY: Bureau of Mineral Resources, Geology and Geophysics

DRILLING PLANT:

MAKE	Mobile (made by Fox Manufacturers under license
TYPE	B-40-L from U.S.A.)
DEPTH RANGE	500 feet with $2\frac{3}{8}$" drill pipe
ENGINE	Hydraulic drive powered from Leyland 'Comet' truck engine (Leyland E.O. 400)

MAST:

MAKE	Mobile
TYPE	Welded steel
RATED CAPACITY	14,000 lbs.
WORKING HEIGHT	$13\frac{1}{2}$ feet

ROTARY TABLE:

None. Unit is fitted with a top drive power head. However, a light weight shop-made breakout table is fitted.

PUMP:

MAKE	Gardner Denver
TYPE	FG-FXF
SIZE	5" x 6"

COMPRESSOR:

MAKE	Armstrong Holland/Jaeger
TYPE	Model A 365
Cubic ft/min	365
PRESSURE	100 psi

PERSONEL AND ADMINISTRATIVE:

SHIFTS RUN

DAILY	1
WEEKLY	5
HOURS PER SHIFT	8
DRILLERS	E.D. Lodwick
	E.T. Reid
	B. Ingram
	W.R. Goddard

B.M.R. NAPPERBY No. 1

POSITION

Napperby Grid Reference 587.5, 179.8*. About 13½ kilometres southwest of Napperby Homestead. Drilling commenced in superficial Cainozoic deposits. RL(est) 620 m

OBJECTIVES

To determine whether Adelaidean-Palaeozoic sediments occur at shallow depth to the south of shallowly dipping outcrops of Vaughan Springs Quartzite.

DRILLING

A total of 456 feet was drilled with two cored intervals. Core 1 was cut in the interval 423 to 433 feet with recovery of 3 feet. The upper part of the cored interval consisted of silcrete with creamy white clay and angular to subrounded quartz fragments. The bottom of the core is a clean white micaceous clay. Core 2 was cut in the interval 446 feet to 456 feet with a recovery of 3 feet. This core is a pale grey micaceous puggy plastic clay with a thin band of black foetid highly carbonaceous material between 455 feet 6 inches and 456 feet.

The hole was plugged with wood and abandoned. No cuttings were taken.

RESULTS

The first 318 feet penetrated unconsolidated Cainozoic sands and gravels. From 318 feet to bottom it is suggested that the plastic clays are of Tertiary age. Relative abundances of Nothofagus pollen obtained from the carbonaceous material at 456 feet suggest an age from post-Eocene to pre-Pliocene (pers. comm. D. Burger, B.M.R.) . Similar carbonaceous clays and lignites have been obtained from water bores drilled near Tea Tree in the northeastern part of the Napperby Sheet area.

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* Grid references refer to 10,000 yd grid.

B.M.R. NAPPERBY No. 2

POSITION

Napperby Grid Reference 565.0, 167.4. About 10 kilometres north-west of Mount Hammond in the Stuart Bluff Range. Ground level about 570 metres (1870 feet). Drilling commenced in superficial Cainozoic deposits.

OBJECTIVES

To determine whether Adelaidean-Palaeozoic sediments are present at shallow depth to the north of the southern margin of the Ngalia Basin.

DRILLING

The hole was drilled to total depth of 368 feet with only one core cut from 185 feet to 194½ feet and a recovery of 4 feet of dark brown ironstone and soft yellow and creamy pink micaceous clay. Cuttings from 21 feet to 345 feet 6 inches were composed of grey, brown and yellow plastic clays, and from 345 feet 6 inches to bottom (368 feet) cuttings of a variety of highly siliceous rock types were obtained. The hole was plugged with wood and abandoned.

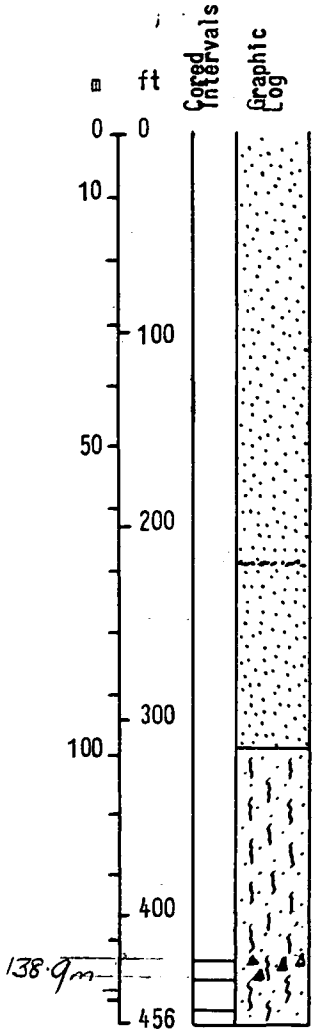
RESULTS

The drilling results indicate a cover of at least 368 feet of Tertiary sediments in this locality. It is thought that the cuttings taken in the interval 345 feet 6 inches to bottom can be correlated with unconsolidated Tertiary boulder beds which crop out about 20 kilometres east of Mount Wedge Homestead.

Fig. 9

B.M.R. NAPPERBY

BOREHOLE No. 1



Unconsolidated
Reddish brown, sub-angular to subrounded

Mi

Charcoal fragments

Light brown
Mi

White, qtz angular, Mi

White with thin bands vuggy silcrete
Grey, Mi
Black, highly carbonaceous

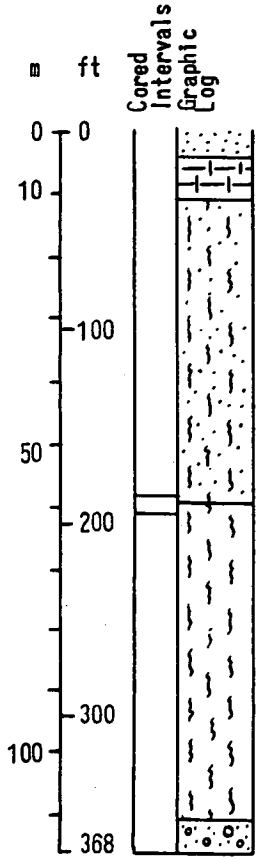
palynology sample 138.9 m (456 ft)

~ 480 m AHD

145 m

B.M.R. NAPPERBY

BOREHOLE No. 2



Reddish brown, unconsolidated

Pink travertine

Grey sandy clay

Brown

White
Thin band dark brown ironstone
Yellow, plastic Mi clay

Grey, plastic

Conglomerate, mainly quartzitic

B.M.R. NAPPERBY No. 3

POSITION

Napperby Grid Reference 535.5, 196.4. About 24 kilometres south of Mount Allan Homestead. Drilling commenced in superficial Cainozoic deposits.

OBJECTIVES

The hole was located about 2 kilometres west of a southwest dipping outcrop of Vaughan Springs Quartzite, and was sited at this point to determine whether Adelaidean-Palaeozoic sediments occur at shallow depth.

DRILLING

A total of 513 feet was drilled with one cored interval from 504 feet to 513 feet and a core recovery of 3 feet. The upper part of the cored interval from 504 feet to 510 feet was probably a soft clay which was flushed out of the core barrel by the drilling mud and lost. From 510 feet to total depth was drilled dry where a soft blue-grey clay and laminated sandstone and shale was encountered. The deeply weathered shale at bottom contained angular fragments of blue-grey chert. The hole was plugged with wood and abandoned.

RESULTS

From 0 to 511 feet the soft, plastic, yellow, red and grey clays in this hole are thought to be of Tertiary age. From 511 feet to total depth the laminated sandstone and shale with minor chert fragments are tentatively correlated with the Treuer Member of the Vaughan Springs Quartzite.

B.M.R. NAPPERBY No. 4

POSITION

Napperby Grid Reference 582.0, 161.7. S.P. 486 on B.M.R. Seismic Traverse 'C', Napperby Creek. About 27 kilometres south-south-west of Napperby Homestead. Drilling commenced in superficial Cainozoic deposits.

OBJECTIVES

To determine whether the Vaughan Springs Quartzite is overlain by Adelaidean-Palaeozoic rocks at this point.

DRILLING

The hole was drilled entirely in Cainozoic sediments to total depth of 320 feet. Core 1 was cut from 215 feet to 236 feet 6 inches with recovery of 18 feet of yellowish, vuggy travertine with patches of white chalcedony and soft greenish brown highly calcareous clay. Core 2 was cut from 310 feet to 320 feet with a recovery of 7 feet 10 inches of a uniform waxy, grey to mid olive-grey compact clay. Core lost was from 317 feet 10 inches to 320 feet. The hole was plugged with wood and abandoned.

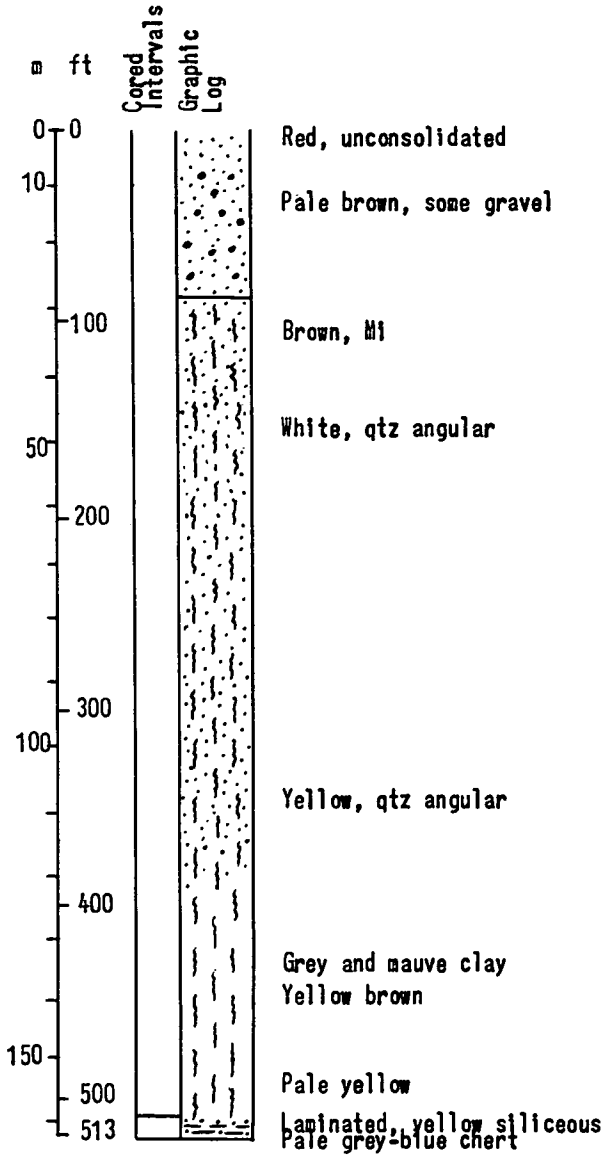
RESULTS

The drilling objective was not achieved. The sequence of travertine and clay is considered to be of Cainozoic age.

Fig. 10.

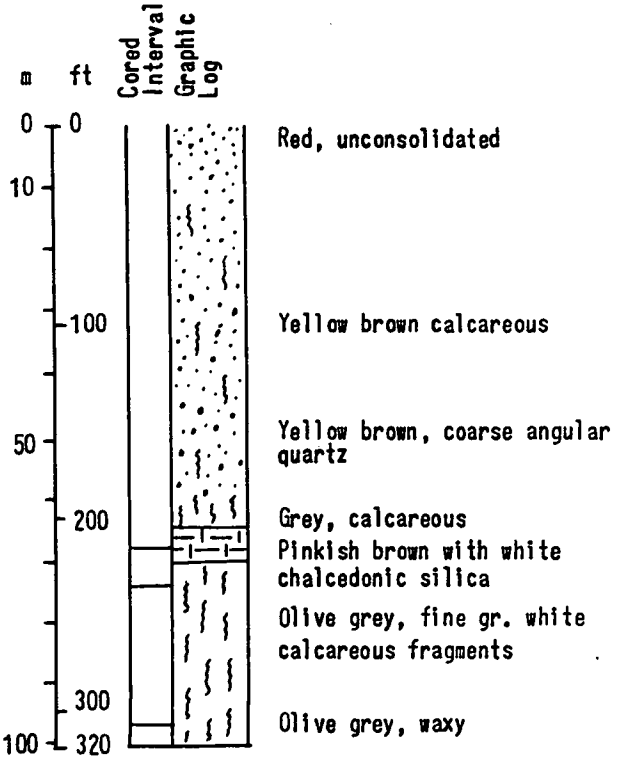
B.M.R. NAPPERBY

BOREHOLE No. 3



B.M.R. NAPPERBY

BOREHOLE No. 4



CONCLUSIONS

The results of the 1968 and 1969 drilling were satisfactory within the limits set by factors such as finance available for the contract and drilled depths.

The main problem common to all holes drilled was that of correlating the borehole cuttings with outcropping formations. This proved a difficult task for the following reasons

(i) Most of the formations are unfossiliferous

(ii) Pronounced lithological changes occur both laterally and vertically in most of the formations

(iii) Many of the formations occur locally and few are present throughout the Basin.

(iv) There may be other, concealed formations subsurface within the sedimentary sequence.

(v) Most of the formations are arenaceous.

Bearing these factors in mind, attempts at correlation have been made and included in the discussion of each stratigraphic borehole.

The information obtained has helped in the interpretation of geological concepts concerning the history and configuration of the Basin. For example, the two bore holes B.M.R. No. 8B and 9 in addition to attaining their primary objectives of determining seismic reflections also proved (if correlations are correct) that Adelaidean sediments are considerably thicker than their surface outcrops suggest. Cainozoic sediments also were found to be considerably thicker than expected. B.M.R. No. 11 for example penetrated over 600 feet of Cainozoic sediments whilst several other holes encountered over 200 feet of Cainozoic deposits.

The electric and gamma ray logging of the boreholes show that consistently good correlation is possible between the lithologies and the logs whilst not showing any outstanding formational characteristics and the logs may ultimately prove valuable for correlation purposes.

Where the water table was encountered samples were collected and analysed by the Animal Industry Branch of the Northern Territory Administration, Alice Springs (Table).

Porosity and permeability tests on cores were carried out by the Petroleum Technology Laboratory of the Bureau of Mineral Resources. The porosity and permeability of the sediments in the cores was on the whole very low (see Table 2) sandstone.

Brief core descriptions are appended (Appendix 1).

REFERENCES

EVANS, T.G., and GLIKSON, A.Y., 1969 - Geology of the Napperby Sheet area Northern Territory. Bur. Miner. Resour. Aust. Rec. 1969/85 (unpubl.).

WELLS, A.T., EVANS, T.G., and NICHOLAS, T., 1968 - The geology of the central part of the Ngalia Basin, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1968/38 (unpubl.).

APPENDIX 1 - CORE DESCRIPTIONS

B.M.R. MOUNT DOREEN No. 7

CORE NO. 1

Depth Cored 202 -212 feet
Interval Cored 10 feet
Total Recovery 9 - 12 inches
Angle of Hole Vertical
Apparent Dip of Core -

DESCRIPTION: Dark green, chloritic, argillite. Core recovery poor. Mostly rock fragments (3" x 1" x ½") showing no obvious structure.

B.M.R. MOUNT DOREEN NO. 8B

CORE NO. 1

Depth Cored	410 - 420 feet
Interval Cored	10 feet
Total Recovery	6 inches
Angle of Hole	Vertical
Apparent dip of core	-

DESCRIPTION: Fragmentary, soft, powdery, ash-grey, very fine grained claystone with sparse fragments of medium grey, sub-angular to angular chert up to ½ inch diameter. No bedding traces visible.

CORE NO. 2

Depth Cored	710 - 717½ feet
Interval Cored	7½ feet
Total Recovery	4 feet
Angle of Hole	Vertical
Apparent Dip of Core	25°-35°

DESCRIPTION: Very fine grained, dark grey, slightly dolomitic, siltstone. Extensively fractured with vertical fractures breaking core up into angular fragments with average diameter of 1 inch. Fractures are in places infilled with marcasite(?). Towards base thin bedding (¼ to ½ inch) is visible, the rock becomes microcrystalline with the bedding planes separated by small cavities (up to 1/16th inch wide). The bedding surfaces exhibit small halite(?) casts. The whole rock is easily scratched by a knife. Pinhead size flecks of a soft, flexible white mineral are common. This may be muscovite mica.

B.M.R. MOUNT DOREEN NO. 9

CORE NO. 1

Depth Cored	670 - 676½ feet
Interval Cored	6½ feet
Total Recovery	6¼ feet
Angle of Hole	Vertical
Apparent Dip of Core	30° to 35°

DESCRIPTION: Dark reddish-brown, finely micaceous siltstone with intervals of very fine sandstone filling in voids caused by brecciation. Weakly developed stylolitic surfaces present. Siltstone looks leached in places - purplish yellow with minor pyrite and mica. Vertical fractures common but core on the whole is not fragmentary.

CORE NO. 2

Depth Cored	792-800 feet
Interval Cored	10 feet
Total Recovery	10 feet
Angle of Hole	Vertical
Apparent Dip of Core	30°

DESCRIPTION: Breccia of angular to sub angular fine siltstone/claystone in matrix of medium to coarse, well rounded, quartz grains. Fragments up to 3 inches long are slightly dolomitic. Slump structures are common. Beds of dark chocolate brown siltstone interfinger with coarse, well rounded quartz sandstone.

B.M.R. MOUNT DOREEN NO. 10

CORE NO. 1

Depth Cored	310 - 320 feet
Interval Cored	10 feet
Total Recovery	9 feet 1½ inches
Angle of Hole	Vertical
Apparent Dip of Core	0 - 5°

DESCRIPTION: Pale greenish grey, coarse grained quartz with feldspar and mica common. Sub-angular grains with pebble bands indicating bedding. The rock is a poorly sorted arkose. Most of the pebbles are sub-angular, the largest has a diameter of ¾ inch (average ¼ inch diameter). Some bands are richer in feldspar than others. Some quartz grains have a vitreous lustre. The grain size is more medium grained towards the centre of the core.

Rock is fairly tight and core has no vertical fracture. Only a few fractures along planes close to horizontal.

CORE NO. 2

Depth Cored	370 - 380 feet
Interval Cored	10 feet
Total Recovery	8 feet 8 inches
Angle of Hole	Vertical
Apparent Dip of Core	20°

DESCRIPTION: Medium brown, soft mudstone passing down into very pale olive green-grey mudstone with thin streaks of black carbonaceous(?) material. Very fine mica visible on bedding plane. Carbonaceous material does not always form continuous layers - it is often broken up into small discontinuous fragments. Small scale cross-lamination visible in places. Thin intervals of siltstone with fragments of fresh feldspar and small lenses of pyrite occur towards the middle of the core. With increase in depth the siltstone is replaced by coarse grained micaceous arkosic sandstone. The quartz and feldspar grains are sub-angular in shape.

CORE NO. 3

Depth Cored	525 - 527 feet
Interval Cored	2 feet
Total Recovery	2 feet
Angle of Hole	Vertical
Apparent Dip of Core	Less than 5°

DESCRIPTION: Light grey medium grained feldspathic quartz sandstone. Feldspar is fresh, sub-angular, associated with sparse, fine mica. The quartz grains commonly have a vitreous lustre, sporadic dark green mud pellets are common and the rock has a silica cement. Pyrite pockets are visible in places.

B.M.R. MOUNT DOREEN NO. 11

CORE NO. 1

Depth Cored	480 - 490 feet
Interval Cored	10 feet
Total Recovery	8 feet ? inches
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: The core consists almost entirely of dark green waxy clay with sporadic gypsum plates. It is slightly calcareous. The top 6 inches of core is a dark reddish brown soft clay which is separated from the green clay by a large ball (3" diameter) of gypsum.

B.M.R. MOUNT DOREEN NO. 12

CORE NO. 1

Depth Cored	205 - 215 feet
Interval Cored	10 feet
Total Recovery	7½ feet
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Friable, reddish brown, vuggy, pebbly, ferruginous silty sandstone. Pebbles up to ½ inch diameter. Poorly cemented.

CORE NO. 2

Depth Cored	600 - 610 feet
Interval Cored	10 feet
Total Recovery	7½ feet
Angle of Hole	Vertical
Apparent Dip of Core	15° - 20°

DESCRIPTION: Poorly sorted, coarse, pebbly arkosic sandstone. Pebbles are up to 1 inch in diameter.

B.M.R. MOUNT DOREEN NO. 13

CORE NO. 1

Depth Cored	400 - 410 feet
Interval Cored	10 feet
Total Recovery	1½ feet
Angle of Hole	Vertical
Apparent Dip of Core	60°

DESCRIPTION: Fine to medium grained sub-rounded to well rounded pale grey quartz sandstone. Moderate to good sorting, silty in part with traces of pyrite scattered throughout. Well rounded small black grains of unidentified mineral common.

CORE NO. 2

Depth Cored	580 - 585 feet
Interval Cored	5 feet
Total Recovery	3 feet 6 inches
Angle of Hole	Vertical
Apparent Dip of Core	60°

DESCRIPTION: As for Core No. 1. Bedding is delineated by thin black streaks. Small but noticeable feldspar content.

B.M.R. MOUNT DOREEN NO. 14

CORE NO. 1

Depth Cored	55 - 57 feet 3 inches
Interval Cored	2 feet 3 inches
Total Recovery	2 feet "
Angle of Hole	Vertical
Apparent Dip of Core	25° - 30°

DESCRIPTION: Dark reddish brown silty dolomite. Thin bedded, finely micaceous. Thin ($\frac{1}{2}$") interbeds of fine sand. Some laminations are feldspar(?) rich.

CORE NO. 2

Depth Cored	180 - 180 feet $7\frac{1}{2}$ inches
Interval Cored	$7\frac{1}{2}$ inches
Total Recovery	4 inches
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Reddish brown micaceous silty dolomite. Very fragmentary and very hard to core.

B.M.R. NAPPERBY NO. 1

CORE NO. 1

Depth Cored	423 - 433 feet
Interval Cored	10 feet
Total Recovery	3 feet
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Upper part of core coarse grained yellowish-grey vuggy silcrete consisting of angular quartz fragments set in clay matrix. Lower part of core soft, white, micaceous clay with scattered sub-rounded quartz grains.

CORE NO. 2

Depth Cored	446-456 feet
Interval Cored	10 feet
Total Recovery	3 feet
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Pale to mid grey micaceous clay with a 3 inch band at 456 feet of 6 inches of black lignitic material yielding abundant plant pollen.

B.M.R. NAPPERBY NO. 2

CORE NO. 1

Depth Cored	185 - 194½ feet
Interval Cored	9½ feet
Total Recovery	4 feet
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Tough, dark reddish-brown compact ironstone with voids lined with iridescent limonite and cryptocrystalline silica. Soft, yellow-brown micaceous clay with white mottling is succeeded by a very soft highly micaceous creamy pink clay.

B.M.R. NAPPERBY NO. 3

CORE NO. 1

Depth Cored	504 - 513 feet
Interval Cored	9 feet
Total Recovery	3 feet
Angle of Hole	Vertical
Apparent Dip of Core	20°

DESCRIPTION: Very soft blue-grey clay with maroon and yellow mottling followed by a finely laminated grey sandstone and yellow shale sequence containing angular fragments of blue-grey chert up to $\frac{1}{2}$ inch wide at 513 feet.

B.M.R. NAPPERBY NO. 4

CORE NO. 1

Depth Cored	215-236 feet 6 inches
Interval Cored	21 feet 6 inches
Total Recovery	18 feet
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: Upper part of core is a vuggy, yellowish travertine containing patches of white chalcedonic silica. This is succeeded by a slightly sandy (rounded quartz grains) yellowish green to olive grey compact clay with small patches, nodules of carbonate.

CORE NO. 2

Depth Cored	310 feet - 320 feet
Interval Cored	10 feet
Total Recovery	7 feet 10 inches
Angle of Hole	Vertical
Apparent Dip of Core	-

DESCRIPTION: A uniform greenish grey to mid-olive waxy compact clay.

TABLE 1 - WATER ANALYSES

	BMR Mt Doreen No. 8	BMR Mt Doreen No. 8B	BMR Mt Doreen No. 9	BMR Mt Doreen No. 10	BMR Mt Doreen No. 11	BMR Mt Doreen No. 12	BMR Mt Doreen No. 13
Hardness (Calculated as $CaCo_3$)							
Total	512	830	240	316	244	906	2532
Carbonate	238	301	240	194	227	218	149
Non-carbonate	274	529	Nil	122	17	688	2390
Alkalinity in excess of total hardness	Nil	Nil	64	Nil	Nil	Nil	Nil
Chloride	675	2680	80	300	305	885	1570
Sulphate	314	723	37	151	169	608	1660
Bicarbonate	290	370	371	237	277	265	174
Nitrate	ND	ND	22	22	22	ND	ND
Fluoride	ND	ND	1.0	1.6	1.4	ND	ND
Carbonate	ND	ND	Nil	Nil	Nil	ND	ND
Sodium	490	1760	86	192	255	490	720
Potassium	67	52	31	54	34	92	60
Calcium	71	110	48	50	73	160	553
Magnesium	81	135	29	46	16	123	280
Total dissolved salts	approx. 1990	approx. 5850	705	1054	1152	2625	approx. 5030
Residue on evaporation	3000	6500	-	-	-	3000	6000
pH	ND	ND	8.3	8.1	8.1	ND	ND
Remarks	Unsuitable for human consumption due to excess sulphate content.	Unsuitable for human comsumption due to excess dissolved salts	Suitable for adults but not infant children due to excess nitrate	Unsuitable for human consumption due to excess fluoride.	Suitable for adults but not for infant children due to excess nitrate.	Unsuitable for human consumption due to excess sulphate.	Unsuitable for human consumption due to excess salts.

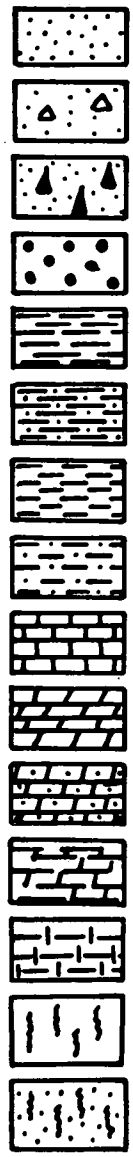
Results in milligrams per litre of filtered sample
ND - Not determined
All boxes are referred to Reference No SN 70/169 and Specimen Advice. Note SAN No. 4465 in the files of the Northern Territory Administration - Animal Industry Branch.
Analyses by Animal Industry Branch - N.T.A., Alice Springs.

TABLE 2 - CORE ANALYSES

STRATIGRAPHIC BORE NO.	CORE NO.	SAMPLE DEPTH	AVERAGE EFFECTIVE POROSITY TWO PLUGS (%Bulk Vol.)	ABSOLUTE PERMEABILITY (millidarcy) V	ABSOLUTE PERMEABILITY (millidarcy) H	AVERAGE DENSITY (gm/cc) Dry Bulk	AVERAGE DENSITY (gm/cc) Apparent Grain
BMR Mt Doreen No. 9	1	674'8" - 675'3"	33.9	1.9*	12*	1.72	2.63
	2	792'0" - 793'9"	6.9	0.16	<0.1	2.62	2.82
	2	796'10" - 797'10"	7.0	<0.1	<0.1	2.64	2.84
	2	797'10" - 798'6"	9.2	<0.1	0.12	2.42	2.66
				* Fractured			
BMR Mt Doreen No. 10	1	311'0" - 312'7"	12.4	3.2	4.3	2.30	2.63
	1	314'4" - 316'3"	12.4	14	23	2.29	2.62
	2	372'6" - 372'10"	13.7	0.1	0.1	2.37	2.74
	2	373'2" - 373'5"	10.1	0.1	0.14	2.47	2.74
	2	378'2" - 378'8"	8.1	0.41	1.2	2.41	2.62
	3	525'0" - 527'0"	9.0	0.88	1.1	2.39	2.63
BMR Mt Doreen No. 12	1	213'9" - 214'4"	34.3	495	810	1.82	2.76
	2	600'0" - 601'4"	8.8	1.5	1.5	2.40	2.63
	2	605'3" - 606'0"	9.1	0.95	1.5	2.40	2.63
BMR Mt Doreen No. 13	2	590' - 594'	5.3	0.24	0.14	2.50	2.63
BMR Mt Doreen No. 14	1	55'0" - 57'3"	4.0	<0.1	<0.1	2.58	2.69

ANALYSES BY PETROLEUM TECHNOLOGY LABORATORY, B.M.R., CANBERRA

SYMBOLS USED IN GRAPHIC LOGS



SANDSTONE

SANDSTONE WITH SILCRETE FRAGMENTS

PORCELLANITIC SANDSTONE WITH CHERT FRAGMENTS

COARSE SANDSTONE OR GRIT

SILTSTONE

SANDY SILTSTONE

CLAYSTONE

SANDY CLAYSTONE

LIMESTONE

DOLOMITE

SANDY DOLOMITE

DOLOMITIC SILTSTONE

TRAVERTINE

CLAY

SANDY CLAY

Grain Size

f — fine

m — medium

c — coarse

Mi Micaceous

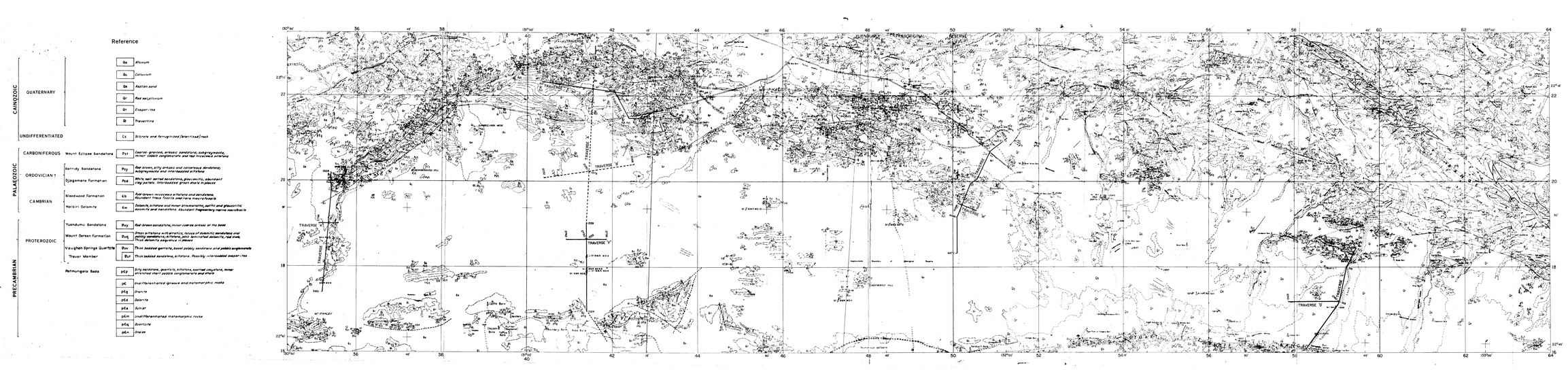
Fe Ferruginous

≡ Laminated

Graded bedding

Slumped

Oolites


Reference
CAINOZOIC
QUATERNARY
Qa Alluvium
Qc Colluvium
Qe Aeolian sand
Qr Red soil/colluvium
Qs Evaporites
Qt Travertine
UNDIFFERENTIATED
Cs Silcrete and ferruginised (laterised) rock
PALAEOZOIC
CARBONIFEROUS
Mount Eclipse Sandstone
Pzt Coarse grained, arkosic sandstone, subgreywacke, minor pebbly conglomerate and red micaceous siltstone.
ORDOVICIAN ?
Kennedy Sandstone
Pzy Red-brown, silty arkosic and calcareous sandstone, subgreywacke and fine-textured siltstone.
Djagamara Formation
Pzd White, well-sorted sandstone, glauconitic, abundant clay pellets. Interbedded green shale in places.
CAMBRIAN
Bloodwood Formation
Cb Red-brown micaceous siltstone and sandstone. Abundant trace fossils and rare macrofossils.
Nalbiri Dolomite
Cm Dolomite, siltstone and minor stromatolitic, oolitic and glauconitic dolomite and sandstone. Abundant fragmentary marine macrofossils.
PRECAMBRIAN
PROTEROZOIC
Yuendumu Sandstone
Puy Red-brown sandstone, minor cobble orthose at the base.
Mount Doreen Formation
Pud Green siltstone with erratics, lenses of dolomitic sandstone and pebbly sandstone; siltstone, shale laminated dolomite, red shale. Thick dolomite sequence in places.
Vaughan Springs Quartzite
Puv Thick bedded quartzite, basal pebbly sandstone and pebble conglomerate
Treuer Member
Puv Thick bedded sandstone, siltstone. Possibly interbedded evaporites.
Patmungala Beds
pup Silty sandstone, quartzite, siltstone, scattered conglomerate, minor stretched chert pebble conglomerate and shale
pC Undifferentiated igneous and metamorphic rocks
pCg Granite
pCd Dolerite
pCs Schist
pCm Undifferentiated metamorphic rocks
pCq Quartzite
pCn Gneiss
GUNANBIMA PRE-EMPHASIC RESERVE
TRAVERSE N
TRAVERSE M
TRAVERSE L
TRAVERSE K
TRAVERSE J
TRAVERSE U
MT DOREEN
NAPPERBY
Stratigraphic hole B.M.R. Mt Doreen (MD) and Napperby (N) Position approximate
BMR Seismic Traverse 1967. Position approximate
BMR Seismic Traverse 1968. Position approximate
NGALIA BASIN
GEOLOGY AND LOCATIONS OF
B.M.R. STRATIGRAPHIC BOREHOLES
25 Kilometres
15 Miles
NT/A 309