DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/26

BMR STRATIGRAPHIC DRILLING IN THE NOONKANBAH AND LENNARD RIVER 1:250 000 SHEET AREAS, WESTERN AUSTRALIA, 1972

by

E.C. Druce and B.M. Radke

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CONTENTS

SUMMARY

Five shallow stratigraphic holes drilled on the Lennard Shelf of the Canning Basin during 1972 penetrated sections in the Middle to Upper Devonian and Lower Carboniferous rocks.

Three of the holes, south of Oscar Range, were continuously cored to an average depth of 67 m; they penetrated quartz sandstone, mudstone, limestone, and dolomite - the shallow-water facies of the Carboniferous Laurel Formation. At two of the sites, it is yet to be shown if the drilling reached the underlying Devonian Fairfield Beds, but in BMR Lennard River 1, the possible contact between the two units is faulted. The stratigraphic relation between these Carboniferous and Devonian rocks is presently being studied in detail.

At Bugle Gap, two holes were drilled with 3-m cores taken at 30-m intervals. One of the holes, 69 m deep, showed Wade Knoll to be a narrow-based pinnacle reef. In the other, the entire section (155 m) consisted of calcareous mudstone and interlaminated limestone of the Devonian inter-reef Gogo Formation.

INTRODUCTION AND GEOLOGY

The West Canning Basin Field Party operated in the Lennard Shelf area of the Canning Basin from May to September 1972. This report records the results of drilling undertaken from 10 June to 15 August in the Fitzroy Crossing area (Fig. 1).

The Canning Basin, situated in the north of Western Australia has an area of about 455 000 km^2 (175 000 sq miles). Deposition began in the Ordovician and continued intermittently into the Tertiary. The Lennard Shelf forms the northwest margin of the basin where Ordovician deposits of the Prices Creek Group are overlain by middle(?) and late Devonian carbonates which form a reef complex (Playford & Lowry, 1966). Playford and Lowry subdivide the complex into four 'facies' based on a reconstruction of the original physiography; they recognize back-reef, reef, fore-reef, and inter-reef facies in a sequence from shallow to deeper water.

Towards the end of the Devonian, reef growth ceased and the basin filled with interbedded mud, sand, and carbonate sediments, which now form the Fairfield Formation (Playford & Lowry, 1966) of late Upper Devonian to early Lower Carboniferous age (Thomas, 1960).

The drilling (Fig. 2) was designed to help in the understanding of two facets of the Devonian-Carboniferous geology of the Lennard Shelf. Firstly by, in order to test the assumption based on the presence only of Stringocephalus (Veevers, 1959) that the inception of reef growth was in the late Middle Devonian, the BMR Noonkanbah 1 and 5 holes (Fig. 3) were spudded at two locations so as to penetrate the flat-lying early Frasnian (Upper Devonian) Gogo Formation and Middle Devonian rocks of the inter-reef facies. Unlike the reef and back-reef facies, the inter-reef and fore-reef facies commonly yield diagnostic conodont assemblages which can be used in correlation problems of this type.

Secondly, three holes (Fig. 4), were drilled in the Fairfield Formation (as defined by Playford & Lowry, 1966) to investigate the existence of two distinct components: the Carboniferous Laurel Formation as defined by Thomas (1957), and the Upper Devonian Fairfield Beds of Guppy, Lindner, Rattigan & Casey (1958). Investigation of the nature and relations of these units has been hindered in the past by lack of outcrop. The effect of drilling was to provide a link between the oldest known Carboniferous rocks and subsurface equivalents of nearby outcropping Devonian rocks, and hence to reveal the nature of the Devonian-Carboniferous boundary in the Canning Basin.

Added to this, it was hoped that information from these three holes in the Fairfield Formation would permit a more precise determination of the time and reason for the cessation of reef growth. In some areas, such as the western end of the Oscar Range, the Fairfield Formation interfingers with rocks of the back-reef facies of the Pillara Limestone. In the Horseshoe Range, however, the Fairfield Formation conformably overlies the Pillara Limestone.

RECORD OF HOLES DRILLED

The holes were named after the 1:250 000 Sheet areas. Thus, BMR Noonkanbah 5 was the fifth hole drilled by BMR on the Noonkanbah Sheet.

Lennard River 1, 2 and Noonkanbah 4 were all continuously cored to total depth. Noonkanbah 1 and 5 were cored at approximately 30-m intervals. S.P., gamma-ray, and resistivity logs were run on all holes using a portable "Geo-Logger". Details of the drilling are shown in Table 1.

A Mayhew 1000 rig of the Petroleum Technology Section (BMR) was used under the charge of L. Keast (driller). This rig was equipped with approximately 200 m of drill pipe, a 3 m core barrel, and equipment for drilling with mud.

The cores and cuttings from all holes were quartered: one half is to be used to destruction for palaeontological, geochemical, and petrological studies; one quarter is being stored at the BMR Core and Cuttings Laboratory, Fyshwick, A.C.T., and the other quarter is now at the Geological Survey of Western Australia.

Cores and cuttings from each hole were described in the field. Following re-examination of the cores in Canberra, lithological and wireline logs were prepared (Plates 1 to 6). The symbols and abbreviations used on these plates are tabulated in Figure 5 and Table 2.

The whole of each core was photographed in colour; the prints and negatives are held at BMR. The core intervals that were photographed, are indicated on the plates.

Description of holes

BMR NOONKANBAH 1

Position: Near Sadler Ridge and Longs Well Creek. Noonkanbah SE/51-12; 18°34'13"S, 125°58'16"E (Fig. 3).

Objectives: To penetrate the flat-lying, inter-reef Gogo Formation to determine when growth of the reef complex started.

Drilling: The hole reached a T.D. of 155.4 m, all Gogo Fm. Five cores were cut at approximately 30-m intervals.

Geologists: G. Young (BMR), J. Backhouse (GSWA), B. Radke (BMR)

BMR NOONKANBAH 4

Position: On track to Old Oscar Homestead about 5 km WNW of Oscar Hill. Noonkanbah SE/51-12; 18°04'30"S, 125°25'00"E (Fig. 4).

Objectives: To penetrate the sequence between the oldest outcrops of Carboniferous and the shallow-dipping Devonian sequence exposed at Oscar Hill.

Drilling: The upper 3.3 m was drilled; the remainder of the hole to T.D. 68.9 m was cored.

Geologists: E.C. Druce and B. Radke (BMR).

BMR NOONKANBAH 5

Position: By Wade Knoll. Noonkanbah SE/51-12; 18°40'00"S, 125°59'40"E (Fig. 3).

Objectives: To determine whether Wade Knoll was a pinnacle reef with a greatly expanded base at depth, and to recover older inter-reef sediments.

Drilling: Drilling was slow because fans of hard allochthonous reef material from the pinnacle reef are interbedded with shales. Although planned to 160 metres the hole was terminated at 68.6 metres. Three 3-m cores were cut at approximately 30-m intervals.

Geologists: G. Young (BMR), J. Backhouse (GSWA), B. Radke (BMR).

BMR LENNARD RIVER 1

Position: At base of Thomas's (1957) Type Section I in the Laurel Formation, 3 km NW of Twelve Mile Bore, Lennard River SE/51-8, 17°55'00"S, 125°14'30"E (Fig. 4).

Objectives: To investigate the sequence immediately below Thomas's Laurel Formation type section and relate the exposures in the Twelve Mile Bore area with those near Oscar Hill (BMR Noonkanbah 4).

Drilling: The major fault along the front of the Oscar Range was intersected at about 54 m. The upper 3 m was drilled; the remainder to T.D. 63.4 m was cored.

Geologists: E.C. Druce (BMR), R.S. Nicoll (BMR), B.M. Radke (BMR).

BMR LENNARD RIVER 2

Position: 5 km S of Twelve Mile Bore, Lennard River SE/51-8; 17°57'45"S, 125°16'30"E (Fig. 4).

Objectives: To investigate the concealed sequence above Thomas's Section II of the Laurel Formation.

Drilling: 12.5 m of the upper 14.0 m was drilled in Grant Formation. The remainder of the hole to T.D. 68.9 was cored in the Laurel Formation.

Geologists: E.C. Druce (BMR), R.S. Nicoll (BMR), B.M. Radke (BMR).

PRELIMINARY RESULTS

Inter-reef sediments (155.4 m) were penetrated in BMR Noonkanbah 1; they underlie rocks assigned to the earliest Upper Devonian conodont zone. This thickness of inter-reef sediments suggests that reef growth took place in the Middle Devonian, but an absolute age for the earliest development of the reef could not be determined because the hole did not reach basement.

BMR Noonkanbah 5 was spudded in earliest Upper Devonian sediments and demonstrated that Wade Knoll was a narrow-based pinnacle reef which shed allochthonous reef material into the surrounding inter-reef sediments. Because the beds of allochthonous material are extremely hard, drilling was slow and the second objective, to recover older inter-reef rocks, was not achieved.

The holes in the Fairfield Formation (sensu Playford & Lowry, 1966) provided a more complete picture of the basal Carboniferous sequence. BMR Noonkanbah 4 connected the basal part of the Laurel Formation with the uppermost rocks of the Devonian; BMR Lennard River 1 recovered the sequence of the Laurel Formation between the base of Type Section I (of Thomas, 1957) and the horizon at which BMR Noonkanbah 4 was spudded (Fig. 4); BMR Lennard River 2 penetrated rocks younger than any exposed in Type Section II (the upper part of the Laurel type section of Thomas, 1957).

Petrological, palaeontological, and geochemical work is continuing and results will be published in the BMR Report and Bulletin Series.

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TABLE 1

Summary of Drilling

Hole & Number	Latitude (South)	Longitude (East)	Total Depth (m)	Drilling (m)	Coring (m)	Core Numbers	Core Recovery Actual	%	Results
BMR NOONKANBAH 1	18°34'13.5"	125°58'16"	155.4	138.6	3.05	1	2.23	73	0.0-155.4 Light grey mudstone with thin bands of limestone of Gogo Formation
					3.05	2	3.05	100	
					3.05	3	3.05	100	
					1.53	4	1.53	100	
					3.05	5	2.98	97	
					3.05	6	2.37	78	
BMR NOONKANBAH 4	18°04'30"	125°25'00"	68.9	3.3	2.13	1	2.13	100	0.0-36.5 Interbedded micrite and siltstone; thin beds of red-green mottled sandstone.
					3.05	2	1.83	60	
					0.92	3	0.77	84	
					2.82	4	1.75	62	
					3.05	5	3.01	99	
					3.05	6	3.05	100	36.5-68.9 Sandstone and siltstones
					3.05	7	3.05	100	
					1.75	8	1.70	97	
					2.90	9	2.90	100	
					0.30	10	0.30	100	
					3.05	11	3.02	99	
					2.90	12	2.90	100	
					3.05	13	3.05	100	
					3.05	14	2.13	70	
					3.05	15	2.60	85	
					3.05	16	0.38	12	
					1.53	17	1.53	100	
					3.05	18	2.44	80	
					3.05	19	3.05	100	
					3.05	20	2.02	66	
					3.05	21	3.05	100	
					3.05	22	2.68	88	
					3.05	23	2.92	96	
					3.05	24	0.76	25	
					1.53	25	1.53	100	
BMR NOONKANBAH 5	18°40'00"	15°59'40"	68.6	59.74	2.75	1	2.65	96	0.0-68.6 Interbedded yellow to brown calcareous mudstone and hard grey limestone.
					3.05	2	3.05	100	
					3.05	3	3.05	100	
BMR LENNARD RIVER 1	17°55'00"	125°14'30"	63.4	3.05	1.38	1	1.36	98	0.0-21.8 Interbedded limestone and thick red sandstone
					1.68	2	1.51	90	
					3.05	3	2.60	85	
					3.05	4	2.10	66	21.8-50.0 Siltstone with interbedded sandstone and thin dolomitic limestone.
					1.83	5	1.30	71	
					2.57	6	0.89	35	
					3.05	7	2.85	93	
					2.13	8	1.31	62	50.0-63.4 Micrites with interbedded sandstone and green shale.
					1.00	9	1.00	100	
					0.30	10	0.30	100	
					2.60	11	2.33	90	
					2.00	12	2.00	100	
					3.05	13	2.75	90	
					2.60	14	2.44	94	
					2.90	15	2.80	97	
					3.05	16	3.05	100	

Table 1 (Contd)

Hole & Number	Latitude (South)	Longitude (East)	Total Depth (m)	Drilling (m)	Coring (m)	Core Numbers	Core Recovery (m)	Core Recovery %	Results
BMR LENNARD RIVER 1 (Contd)					1.53	17	1.25	82	
					2.75	18	2.75	100	
					2.39	19	0.91	38	
					3.05	20	2.80	92	
					1.06	21	0.82	77	
					3.05	22	3.05	100	
					1.83	23	1.78	97	
					1.37	24	1.30	95	
					3.05	25	2.76	90	
					2.44	26	2.18	90	
					1.53	27	1.22	80	
BMR LENNARD RIVER 2	17°57'45"	125°16'30"	68.9	12.5	1.52	1	0.91	60	0.0-13.6 Grant Fm. Red sandstone conglomerate.
					1.52	2	1.48	97	
					2.74	3	2.20	80	
					3.05	4	2.37	78	13.6-68.9 Laurel Fm. Alternating grey-brown limestone and shale with coquinite lenses.
					2.59	5	1.95	75	
					2.89	6	1.68	58	
					1.67	7	1.61	96	
					2.89	8	2.14	74	
					2.27	9	2.27	100	
					2.89	10	2.14	74	
					2.74	11	2.74	100	
					3.05	12	3.02	99	
					3.05	13	2.93	96	
					3.05	14	2.68	88	
					1.83	15	1.83	100	
					3.05	16	3.00	98	
					3.05	17	3.05	100	
					3.05	18	3.00	98	
					3.05	19	3.00	98	
					3.05	20	3.05	100	
					3.05	21	2.98	97	
					0.38	22	0.38	100	

TABLE 2

Abbreviations used on lithological logs

GRAINSIZE OF SANDSTONES

vf	very fine	(0.06 - 0.12 mm)
f	fine	(0.12 - 0.25 mm)
m	medium	(0.25 - 0.5 mm)
c	coarse	(0.5 - 1.0 mm)
vc	very coarse	(0.1 - 2.0 mm)
gr	granular	(2.0 - 4.0 mm)

OTHER ABBREVIATIONS

$\bar{c}$	with
fe	ferruginous
fr	friable
fs	fissile*
hd	hard*
lst	limestone
mot	mottled
po	porous*
py	pyrite
s	soft*
slk	slickenslides
sty	stylolites
uncons	unconsolidated
vug	vuggy

* qualitative evaluation of these properties

( ) means poor, weakly developed, or rare

___ underlining means good, well developed, or abundant

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TABLE 2 (Contd)

COLOURS

bk	black
blsh	bluish
br	brown
brsh	brownish
dk	dark
dsky	dusky
gy	grey
gysh	greyish
gn	green
gnsh	greenish
l	light
m	medium
mod	moderate
ol	olive
or	orange
p	pale
pk	pink
pksh	pinkish
r	red
rsh	reddish
v	very
wh	white
y	yellow
ysh	yellowish
W	determination of a wet surface
D	determination of a dry surface

Colour determinations were made by visual comparison with the Rock Color Chart (Geol. Soc. of Amer.).

Figure 1

REGIONAL GEOLOGY, FITZROY CROSSING AREA

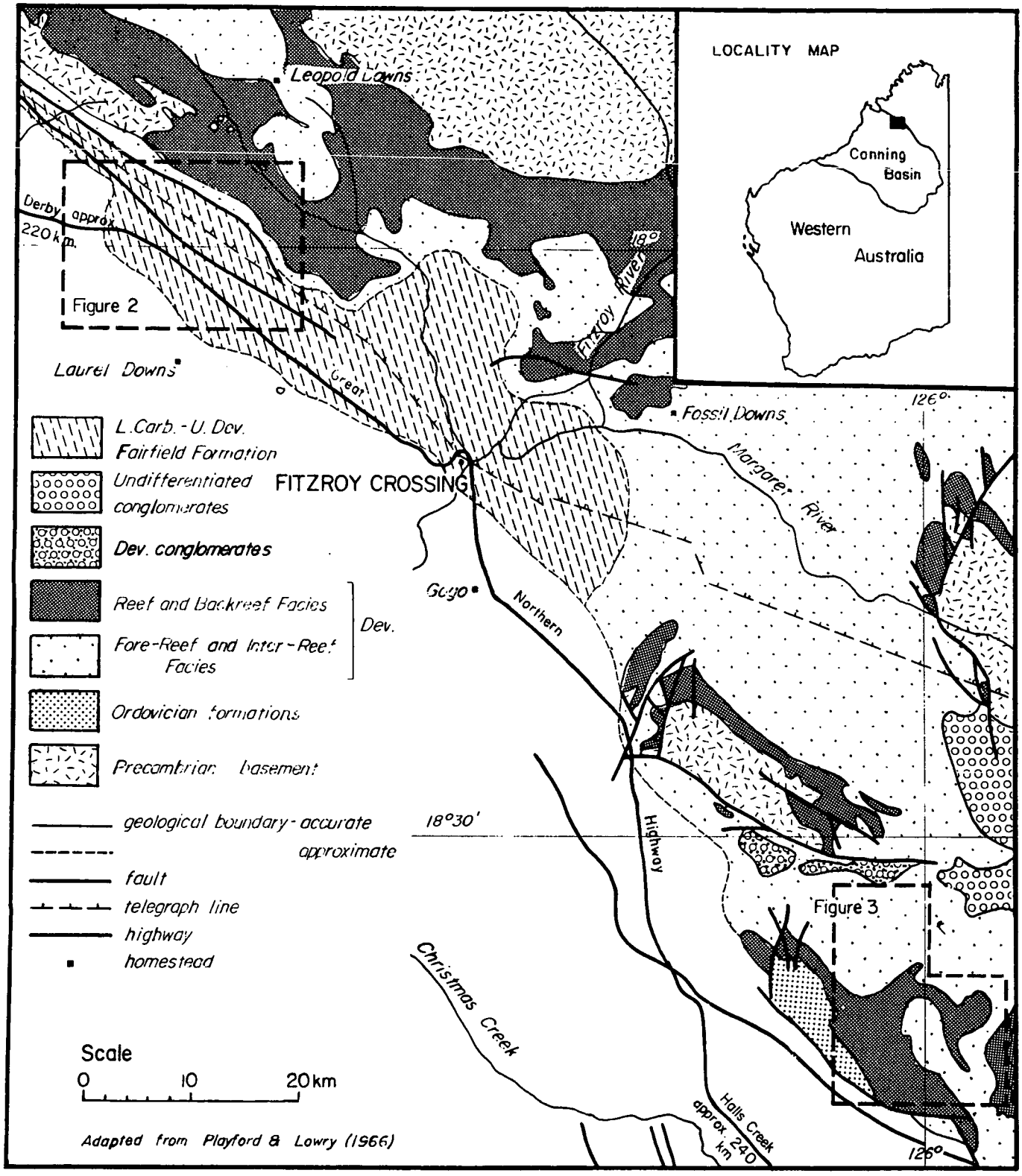

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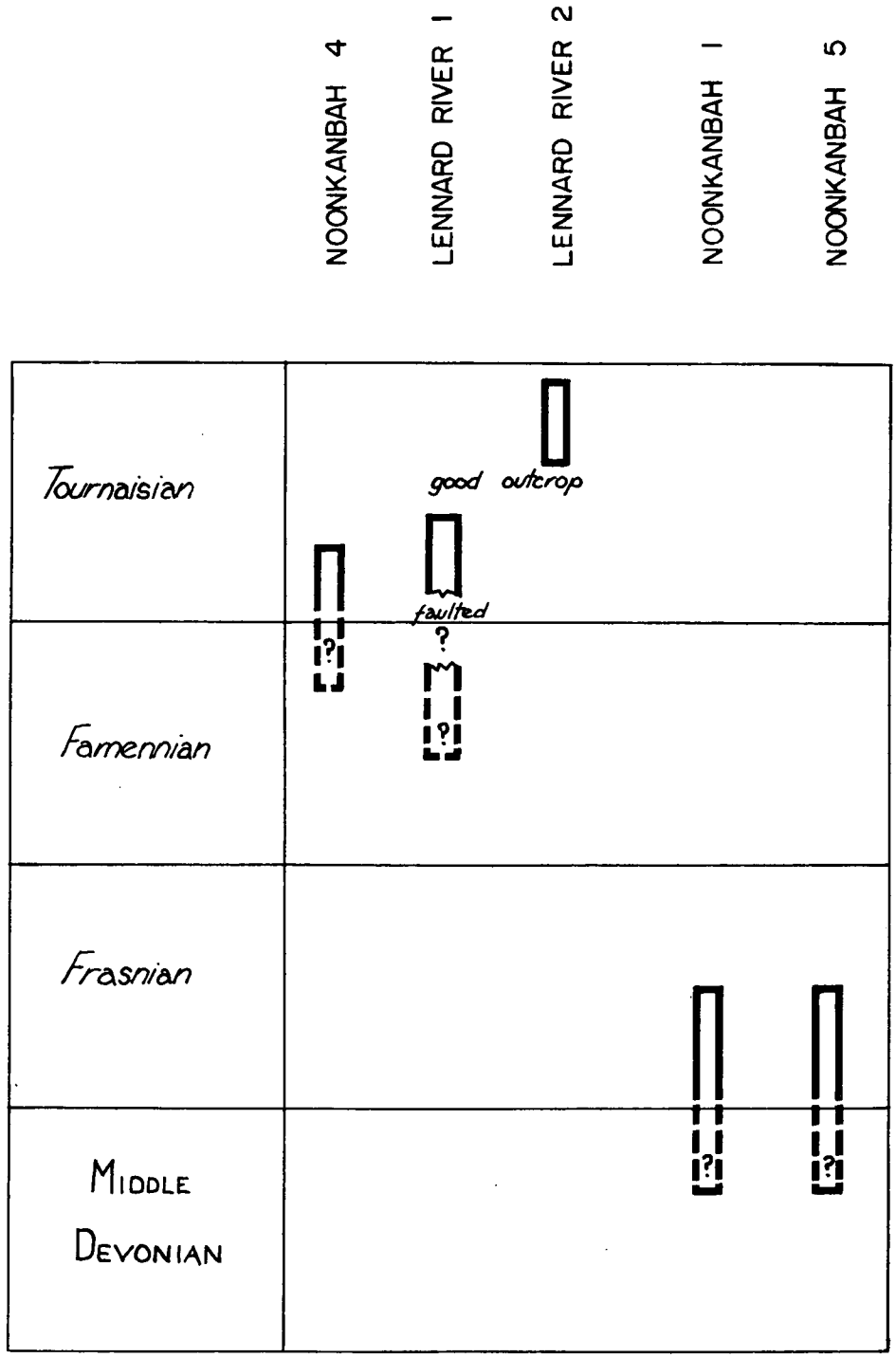
Figure 2

POSSIBLE AGE RELATIONSHIPS OF STRATA DRILLED



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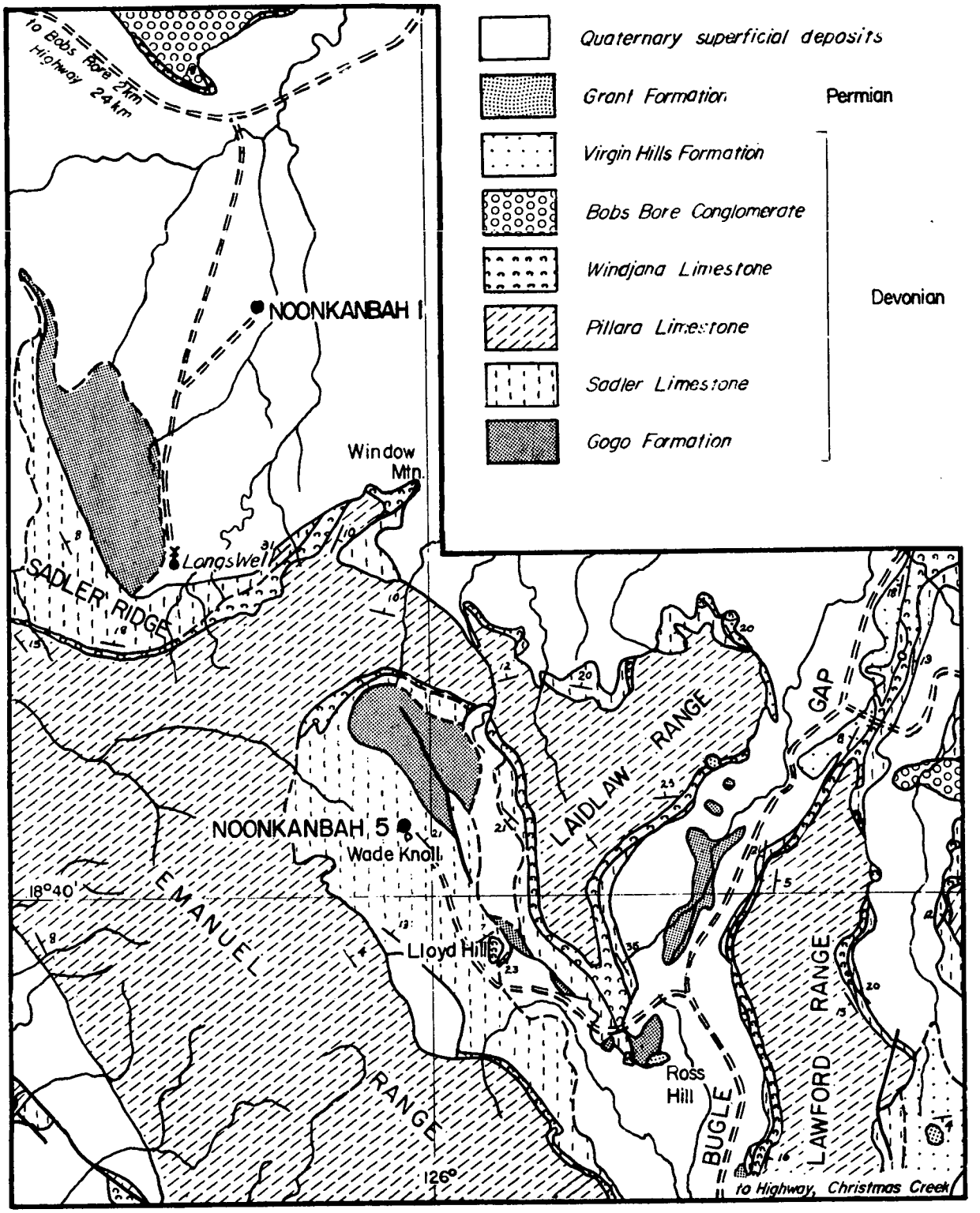
LOCATIONS OF BMR STRATIGRAPHIC DRILLHOLES

Figure 3



Adapted from Playford & Lowry (1966)

geological boundary - accurate

approximate

fault

track

dip and strike of bedding

windpump

stratigraphic hole

0 1 2 4 km

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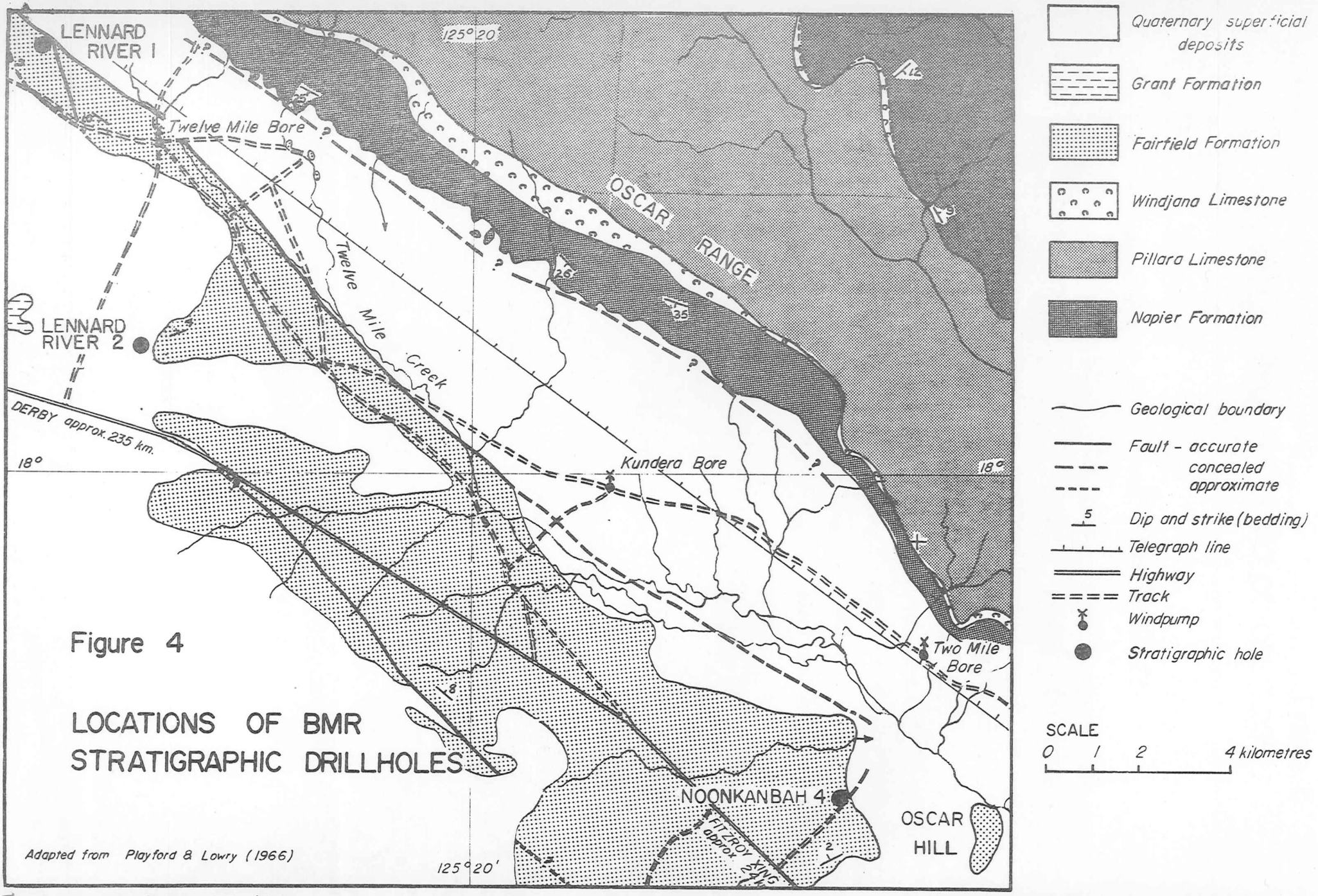

Figure 4

LOCATIONS OF BMR STRATIGRAPHIC DRILLHOLES

Adapted from Playford & Lowry (1966)

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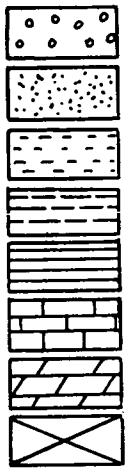
Figure 5

SYMBOLS USED ON LITHOLOGICAL LOGS

Lithologies



conglomerate
sandstone
siltstone
mudstone
shale
limestone
dolomite
no core
limestone interbeds
shale interbeds
calcareous
dolomitic
breccia
solution cavities
sandy

Bedding Structures

thick (30 - 100 cms.)
medium (10 - 30 cms.)
thin (1 - 10 cms.)
laminated (< 1 cm.)
crossbedded
crosslaminated
disturbed bedding
undulose
scour and fill
erosion surface
lensoidal

Sampling

geochemical sample
geochemical sample and thin section

Fossils

macrofossils
gastropods
pelecypods
brachiopods
ostracods
crinoid fragments
encrusting algae
tabulate corals
fish fragments

Photography

colour
black and white

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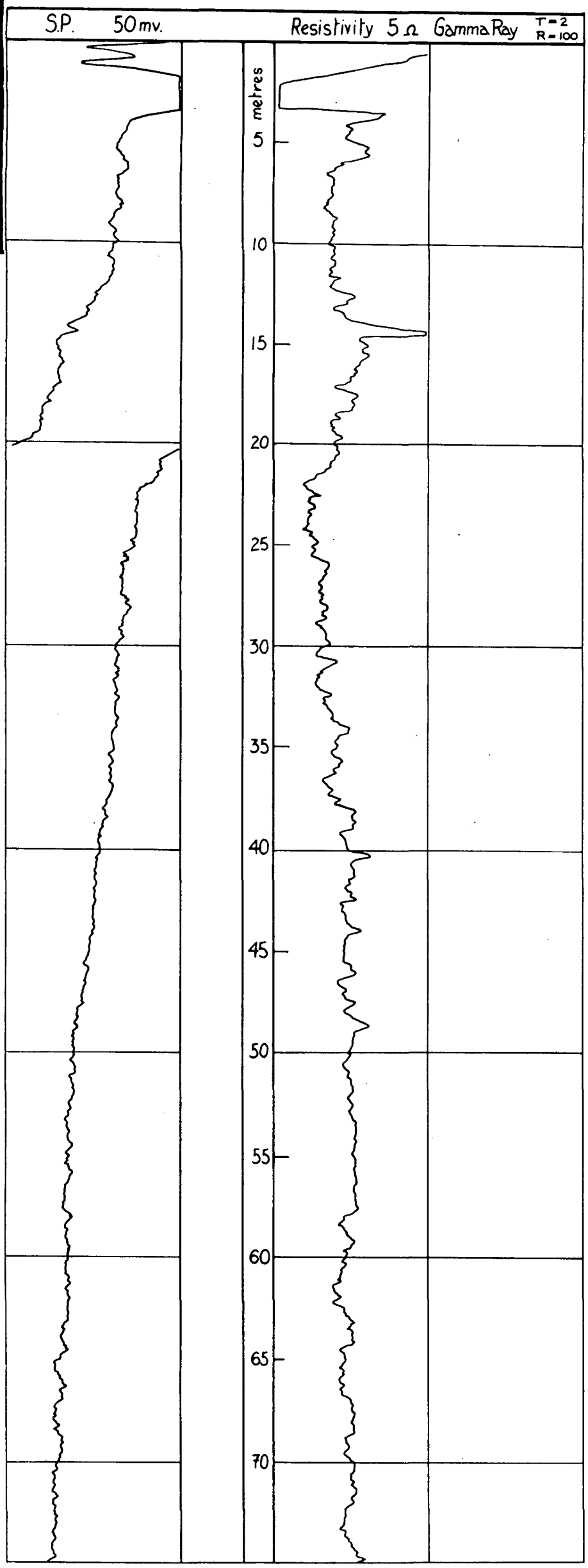
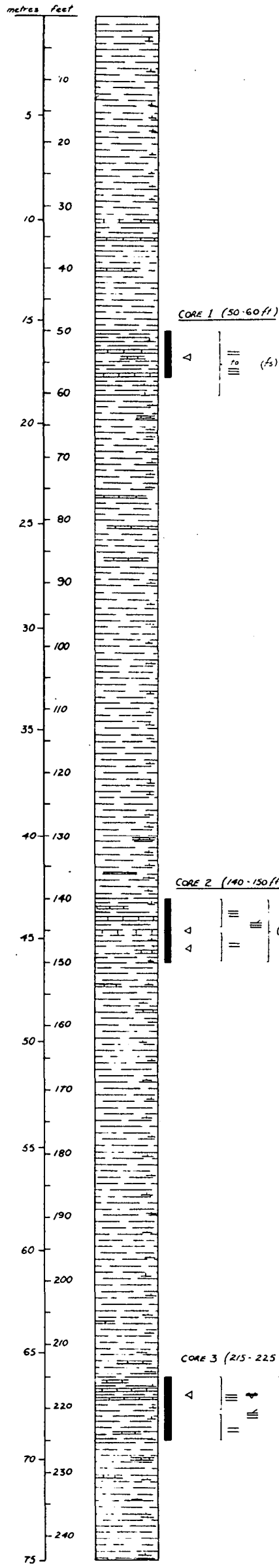
PLATE 1

BMR NOONKANBAH No.1

TD. 155·4 metres





mudstone, l bl gy and dk r, friable, slightly calcareous

mudstone, l bl gy and dk gy, friable, v calcareous

a/above ē some l gy bands of f grained limestone

mudstone; l bl gy and rarely dk rsh gy, friable, v calcareous

CORE 1 (50·60 ft)

(fs) po s colour banded mudstones, mod br to gnsh gy D

mudstone, mod br and gnsh gy D, friable, v. calcareous

as above ē some p gy limestone

mudstone, gnsh gy, friable, v. calcareous

as above; mod br colour alternating ē gnsh gy D

as above; mod br colour dominant

as above

CORE 2 (140-150 ft)

(fs) po s mod br to gnsh gy colour banded mudstone with limestone laminae throughout. The mudstone colour variations are gradational

mudstone, dominantly l gy, friable, v calcareous

as above, dominantly dk gy.

as above

CORE 3 (215-225 ft.)

(fs) (po) hd s mod calcareous gnsh gy to mod br mudstone, thin colour bands with colour changes gradational, or abrupt when separated by wh limestone laminae

mudstone, gnsh gy and mod br; soft, light coloured mudstone (calcareous), dark mudstone sometimes calcareous)

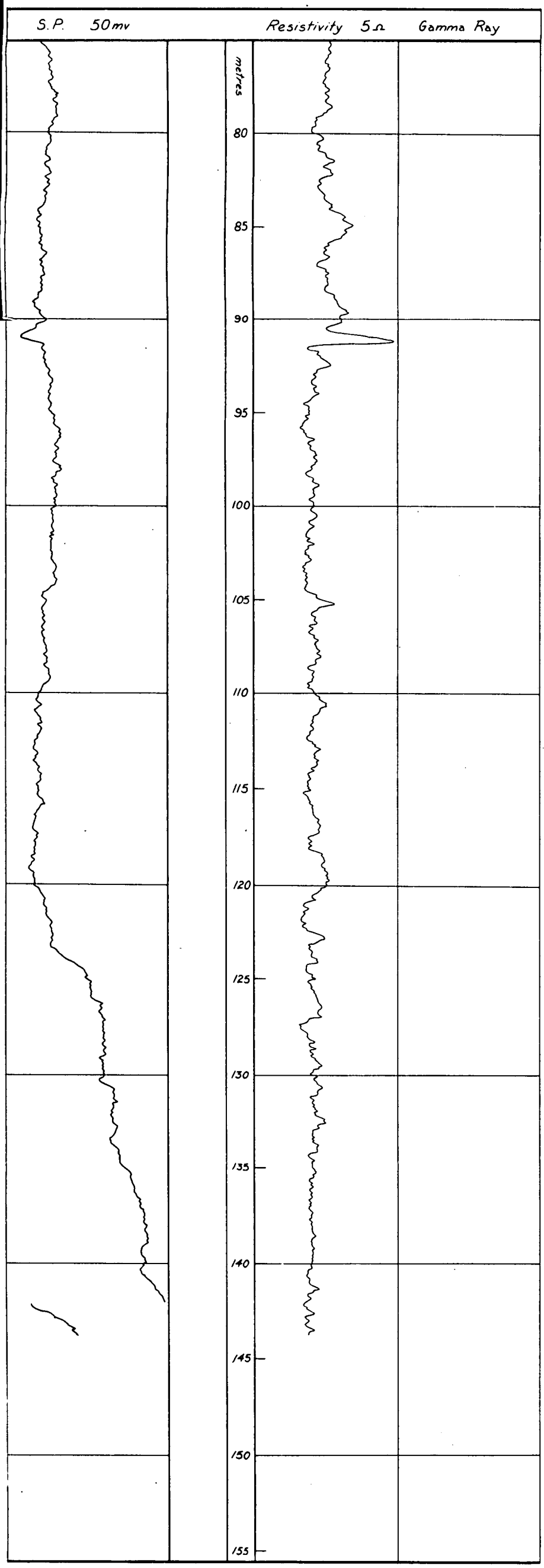
as above, ē some dk gy shale (mod. calcareous)

CONTINUED ON PLATE 2 TO 155·4 metres

SECTION CONTINUED ON PLATE 2

PLATE 2

BMR NOONKANBAH No.1 (contd.)



mudstone, gnsh gy and mod or, soft, light coloured mudstone calcareous, dark mudstone is rarely calcareous
some dk gy shale (mod calcareous)

as above

Core 4 (285-287.3 feet)

(fs) (po) hd s hd mudstone; calcareous, colour banded, gysh r to l ol gy D

mudstone, gnsh gy, soft to firm, v calcareous

as above

as above

as above

as above

Core 5 (380-390 feet)

v.f.py., (fs), (po) mudstone, calcareous, gysh r to l ol.gy.D colour bands interbedded hard siltstones are v calcareous, m to l gy

mudstone, calcareous, gysh r to l ol gy colour bands

mudstone, calcareous, gysh r to lol. gy colour bands noticeable increase in silt content

as above

as above

as above

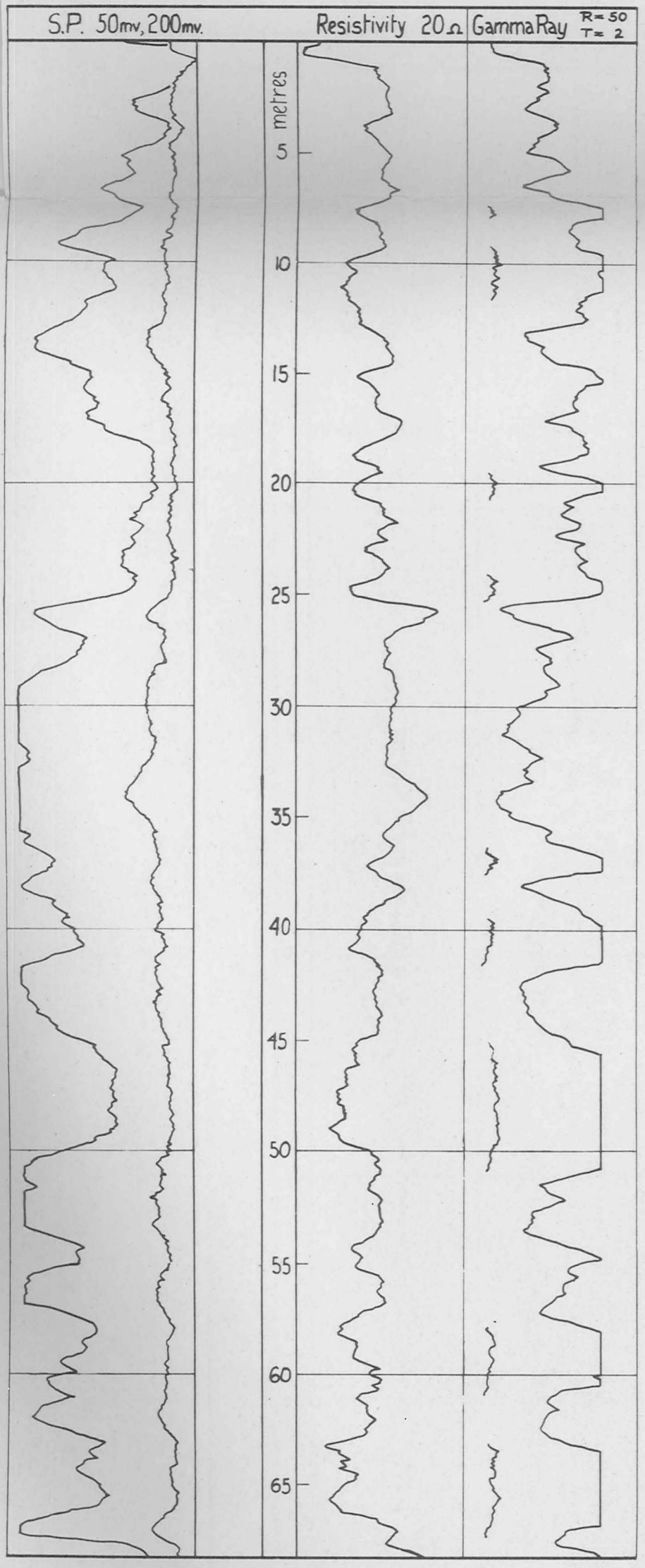
Core 6 (500-510 feet)

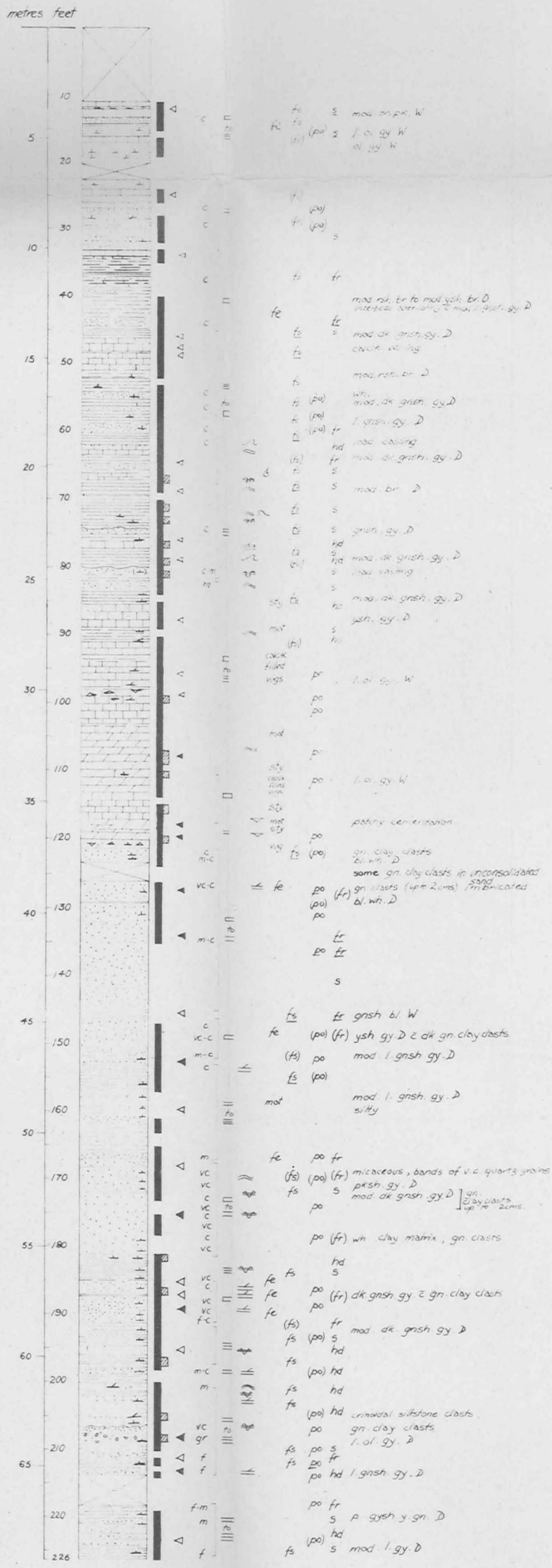
(fs), (po) mudstone; m l gy to gnsh gy gradational colour changes. thin laminae of l.gy. silty limestones throughout

PLATE 3

BMR NOONKANBAH No.4

TD. 68·9 metres





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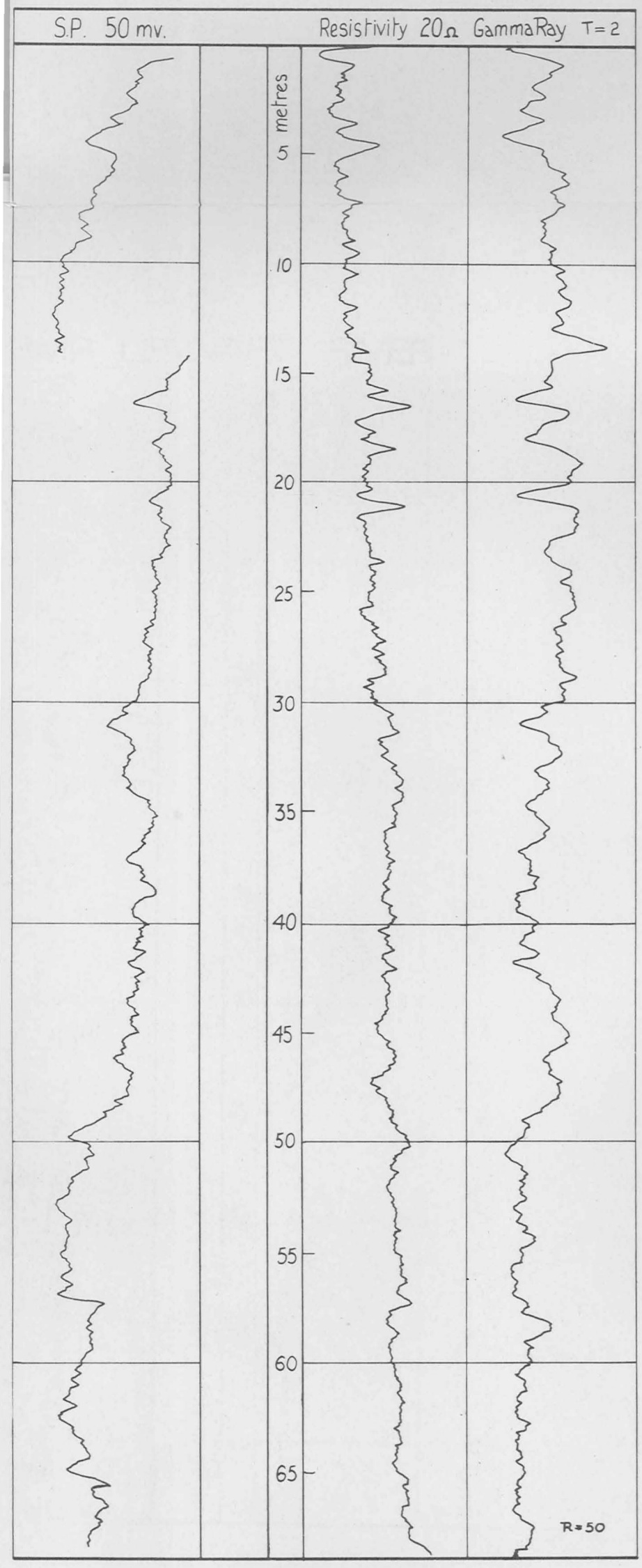
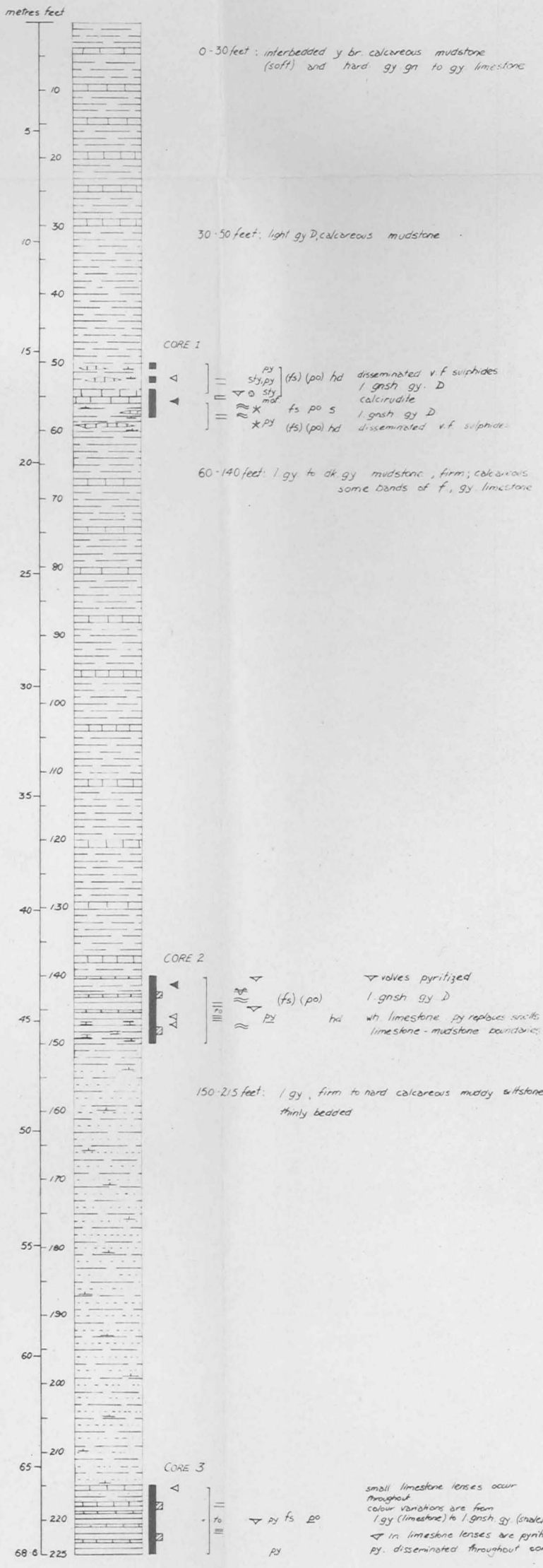
BMR NOONKANBAH No.5

PLATE 4

TD. 68·6 metres





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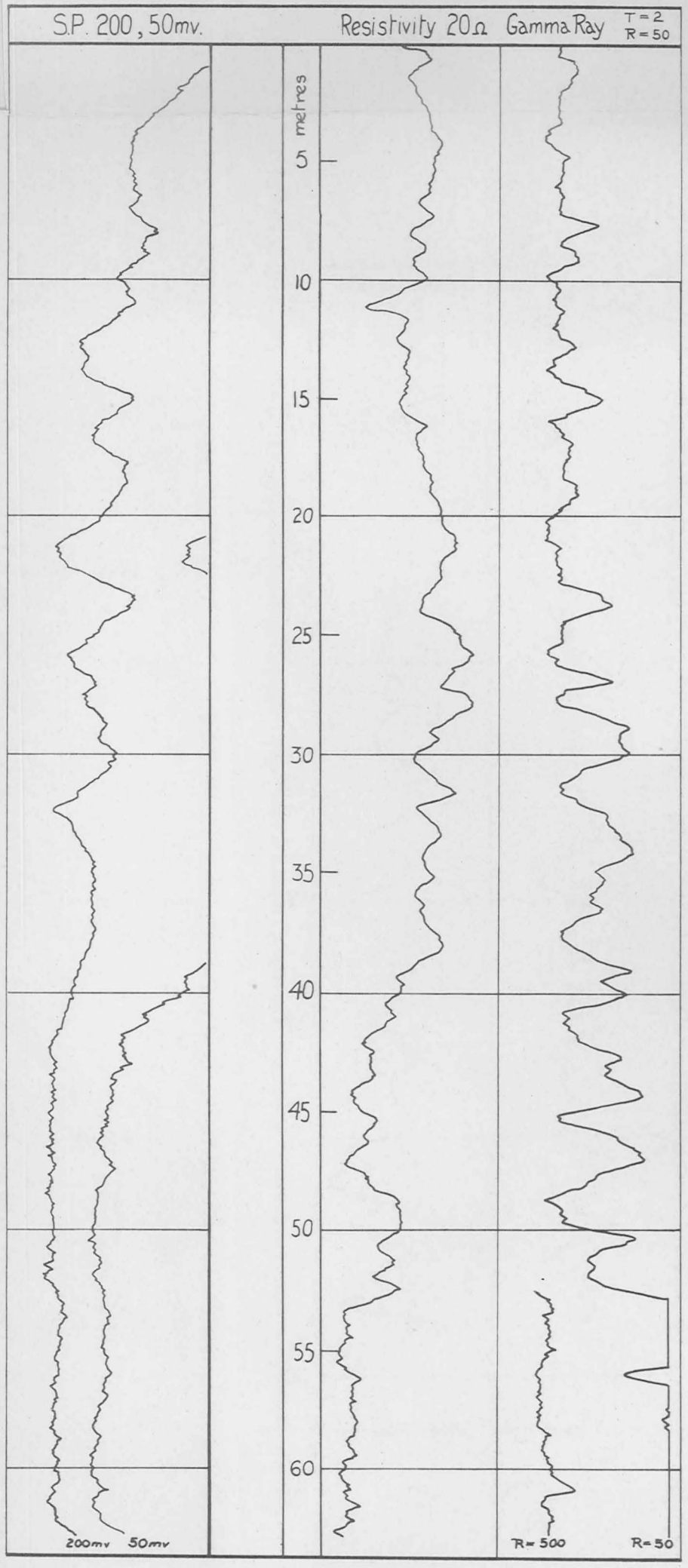
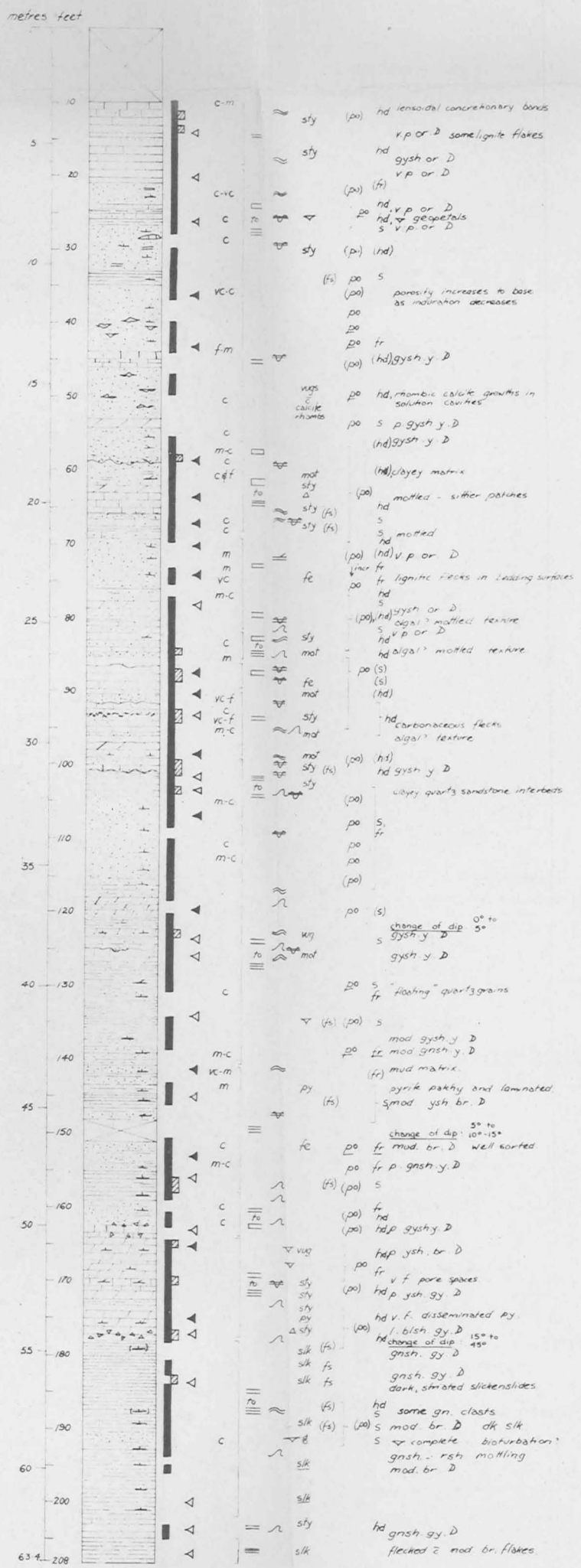
BMR LENNARD RIVER No.1

PLATE 5

TD. 63·4 metres





To accompany Record 1973/26

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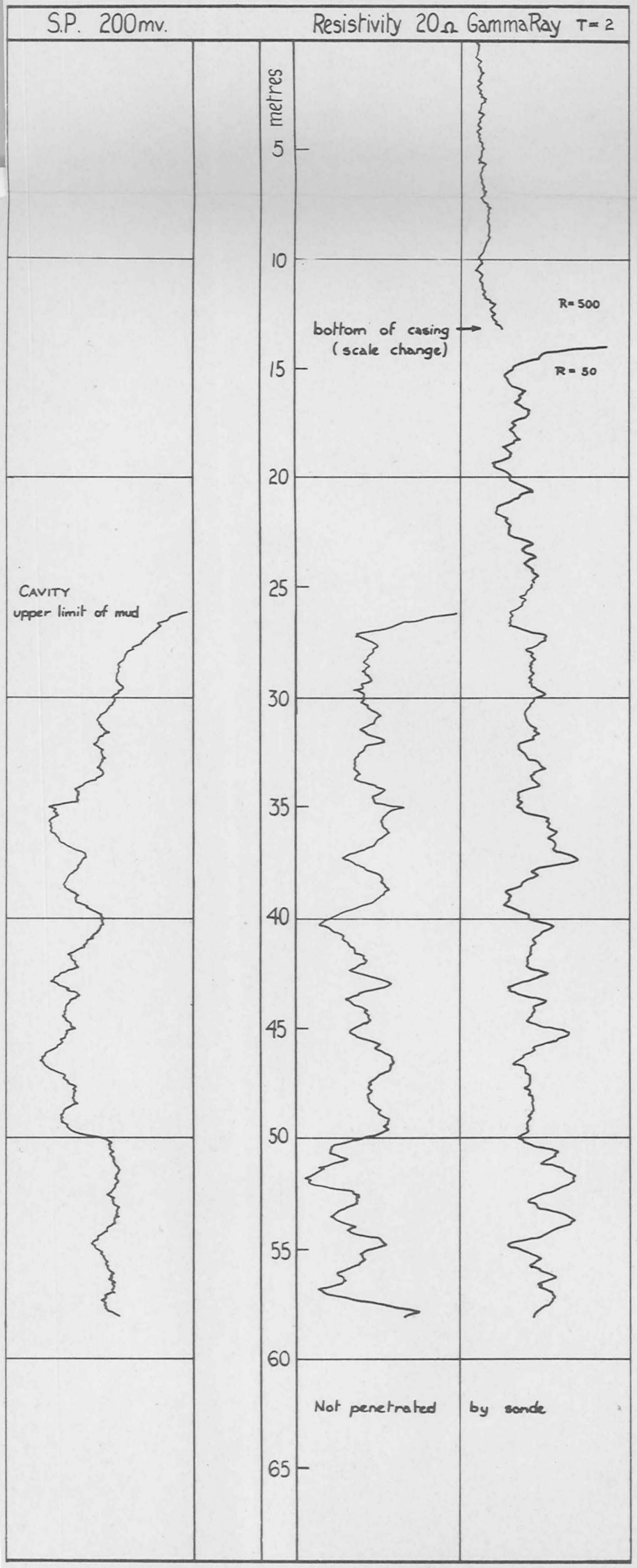
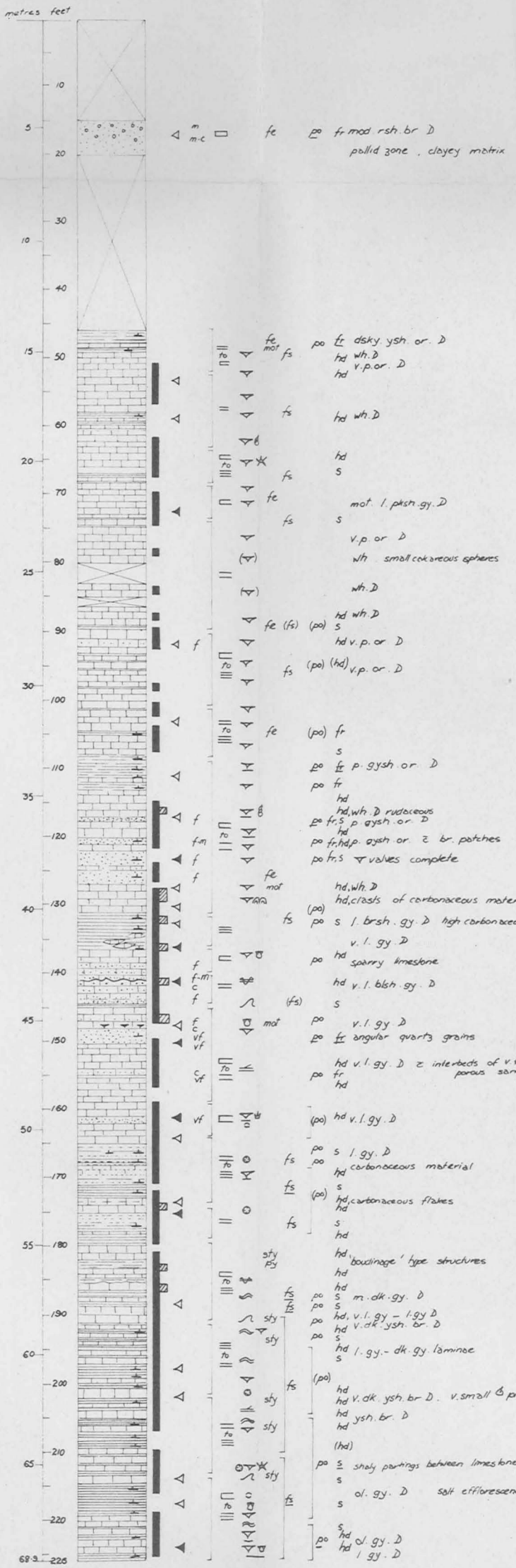
BMR LENNARD RIVER No.2

PLATE 6

TD. 68·9 metres





To accompany Record 1973/26

E 51/A/23

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