69/62
(3)

Copy 3

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 62

Petrological Study of MARTINDALE (A.O.G.) No. 1A Well, Sydney Basin

New South Wales

by

E. Nicholas

Record No. 1969 / 62

Petrological Study of MARTINDALE (A.O.G.) No. 1A Well, Sydney Basin

New South Wales

by

E. Nicholas

Petrological Study of Martindale (A.O.G.) No. 1A Well

Sydney Basin New South Wales

Table of Contents

ABSTRACT

This study is part of a review of the Sydney Basin currently being carried out by the Basin Study Group of the Petroleum Exploration Branch. The main objectives were to define recognisable rock units, and to reassess the petroleum possibilities of the section.

Eighteen lithological units were recognised, and are summarized in Fig. 1. These could be grouped into five major lithogenetic units. The section is Permian throughout; the well spudded in the Newcastle Coal Measures, penetrated the Tomago Coal Measures, the marine sediments of the Mulbring and Branxton Sub-groups, the Lower coal measures and terminated in intermediate to basic volcanics of the Dalwood group.

Although no Farley-Rutherford equivalent was present below the Lower Coal Measures, there was a thin marine interval within this sequence which had lithological affinities to the Farley in Loder (A.O.G.) No. 1.

GENERAL INFORMATION

Well Data

Well Name, No.	:	Martindale (A.O.G.) No. 1A Well
Operating Co.	:	Australian Oil and Gas Corporation Ltd., N.S.W.
Location	:	Latitude 32°30'48", S Longitude ~~151°08'00" E~~ 150°37' 1/250,000 Sheet: Singleton, SI/56/1 General Location: about nine miles SSW of Denman, N.S.W.
Elevation	:	Kelly Bushing : 657' Ground Level : 648'
Total Depth	:	3876' (K.B.)
Logs Run	:	1. Induction Electric Log 474'-3868' 2. Sonic - Gamma Ray - Caliper, 0'-3860' 3. Microlaterolog 474'-3867'
Formation Testing:		Nil
Hydrocarbon	:	Core Laboratories gas detector was used from 115 feet to T.D. but did not operate over the intervals 240'-330' and 340'-475'. Numerous gas shows were recorded in the coal measures.

Major Reference Used in Present Study:

Australian Oil and Gas Corporation Limited, N.S.W. 1967 - Martindale No. 1 and 1A Well Completion Report (unpubl.), by B.R. Boyd.

Summary of Major Reference:

"A.O.G. Martindale Wells No. 1 and No. 1A were drilled to depths of 758' and 3876' respectively approximately nine miles SSW of the town of Denman near the junction of the Goulburn and Hunter Rivers of New South Wales.

"A.O.G. Martindale No. 1 was abandoned at a depth of 758 feet due to crooked hole and casing problems and the rig was skidded 50 feet to the north where Well No. 1A was drilled. This report deals primarily with A.O.G. Martindale No. 1A Well.

"A.O.G. Martindale No. 1A was drilled to a total depth of 3876 feet and was abandoned at this depth in bedded volcanics. A string of new 9 5/8" surface casing was set at 474 feet..... Crooked hole conditions were encountered immediately below the surface casing and controlled weight drilling using drill collar stabilisers was necessary to 1200 feet. Below this depth the hole kept normally straight despite the presence of a number of volcanic sills and maximum deviation measured was 2°. No significant hydrocarbon shows or porous zones of interest were penetrated and no drill stem tests were run.

"Permian sediments and minor intrusive volcanics of probable Tertiary age were encountered to 3,773 feet and were underlain to T.D. by bedded volcanics of probable Permian age.

"The following Permian stratigraphic succession was intersected.

Newcastle Coal Measures	0-380
Tomago Coal Measures	380-2127
Maitland Group :-	
Mulbring Sub-Group	2127-2728

Branxton Sub-group 2728-3426
Muswellbrook Coal Measures 3426-3774
Dalwood Group:-
Allandale Formation (volcanics) 3774-3876

".....The Muree Formation was not recognized as a distinct unit in the Martindale No. 1A Well, while the Greta Coal Measures and the Farley and Rutherford Formations appear to have wedged out before reaching Martindale.

"Towards the basal part of the section intersected at Martindale No. 1A, there is a coal section which has been correlated with the Muswellbrook Coal Measures. Reflection seismic surveys between the wells to the east and the Muswellbrook Anticline indicate that the Greta Coal Measures disappear as a seismic event and are replaced by an event of a different character at a higher stratigraphic level. This latter event is also correlated with the Muswellbrook Coal Measures.

"These data are interpreted to mean a wedge-out or other disappearance of the Greta Coal Measures before reaching the Muswellbrook area and the development in this area of coal seams (the Muswellbrook Coal Measures) in terrestrial sediments equivalent of the lowermost beds of the marine Branxton Sub-group.

"Similar but less strongly developed coal sections were intersected in A.O.G. Camberwell No. 1 and A.O.G. Sedgefield No. 1 above the Greta Coal Measures but, in the absence of palaeontological or palynological determinations, no attempt has been made..... at a precise correlation between the Muswellbrook Coal Measures in the A.O.G. Martindale No. 1A and their suggested equivelant in the eastern wells".

Methods used

(a) Examination of cuttings and core samples. The cuttings samples were examined using a low power binocular microscope, and the results plotted on Petrographic Well Log sheets at a scale of 1"-100' (Plates 1A-C). The cuttings from 1120' to 3400' were examined by G. Parker.

The cores were slabbed and examined under the binocular microscope, and these results, together with the thin section studies of selected core samples, were plotted on Petrographic Core Log sheets (Plate 2).

Eighteen rock units were recognised in the stratigraphic sequence. They were numbered from the surface, and each unit number prefixed by the letter "M", the code letter for this well. Five major groupings of units were established. A summary of the rock units is shown in Fig. 1.

The specific rock names used are from the sedimentary rock classification of Pettijohn (1957), with the addition of the use of the name volcanic subgreywacke, to describe lithic sandstones containing a high proportion of volcanic rock fragments, following the suggestion of Folk (1965), that more descriptive names are sometimes desirable in order to convey the correct impression of the rock type.

GEOLOGY

Units M 1-3

This sequence extends from 50' to 380' and has been subdivided into three units. Unit M2 is considered to be intruded into M3, but has been given unit status for convenience of description. The Company, A.O.G. (1967) has equated the sequence to the Newcastle Coal Measures.

Unit M1 (Plate 1A).

Characteristics: This unit extends from 50' to 150'; it consists of a light grey, fine to medium-grained volcanic subgreywacke at the base, above which is a sequence of interbedded silty, carbonaceous, pyritic claystone, calcitic carbonaceous fine-grained subgreywacke and shale containing pyritic coal laminae and fine veins of calcite.

Boundary criteria: The lower boundary is marked by a sharp increase in radiation intensity on the Gamma Ray Log, reflecting a lithological change to the volcanic sequence below.

Environment and provenance: Shallow water, marginal, probably fresh water reducing conditions are postulated for this unit. The provenance for the volcanic subgreywacke is dominantly volcanic, and for the rest of the unit, mainly sedimentary with a minor granitic source suggested by accessory amounts of plagioclase, zircon and muscovite.

Unit M2 (Plate 1A)

Characteristics: This unit extends from 160' to 320'; it consists of an olive-black basic volcanic, containing hornblende and abundant chlorite, with minor pyroxene and biotite. No evidence of contact metamorphism was observed.

Boundary criteria: The lower boundary is marked by an increase in radiation intensity on the Gamma Ray Log reflecting a lithological change to the sediments of the unit below.

Unit M3 (Plate 1A)

Characteristics: This unit extends from 320' to 380'; it consists of a light grey, fine to medium-grained volcanic sub-greywacke with a low quartz content, and rich in fine-grained felspathic volcanic rock fragments. It is very well indurated with calcite cement and also contains minor siderite and carbonaceous material. Core 1 shows fine, dark and light laminations. This is the same rock type as that at the base of M1.

Boundary criteria: The lower boundary is marked by an increase in radiation intensity on the Gamma Ray Log reflecting a lithological change to the underlying shale.

Environment and provenance: The sediments were deposited under quiet, marginal, probably fresh-water conditions. The provenance is dominantly volcanic.

Units M4-9

This sequence extends from 380' to 2090'; the Company equates it with the Tomago Coal Measures, and it consists of a series of sandstones, siltstones, claystones, shales and coal seams with volcanic intervals. The Company considers the volcanics to be Tertiary intrusives. No evidence of marine influence was detected.

Unit M4 (Plate 1A)

Characteristics: This unit extends from 380' to 550'; it consists of a sandy conglomerate at the base, above which is a seam of black vitreous coal followed by a sequence of carbonaceous siltstone grading to shale at the top of the unit. The conglomerate contains black, green and grey chert, minor sand-sized quartz and carbonaceous material, and calcite and dawsonite cements.

Boundary criteria: The lower boundary is marked by a sharp increase in radiation intensity on the Gamma Ray Log, and a decrease in resistivity on the Resistivity log. This is matched by a change in lithology to the siltstone at the top of the unit below.

Environment and provenance: The sediments were deposited in a shallow, marginal probably fresh-water environment. The provenance is mainly sedimentary, with a minor granitic source suggested by accessory amounts of plagioclase and muscovite.

Unit M5 (Plate 1A)

Characteristics: This unit extends from 550' to 950'; there is a light grey, medium to coarse-grained volcanic subgreywacke at the base, which contains dawsonite and calcite cements and is interbedded with very carbonaceous, pyritic siltstone. This is followed by a fine-grained sequence consisting of thin coal seams, with partings of carbonaceous shale and siltstone grading in parts to fine-grained protoquartzite. Pyrite, and calcite and siderite cements occur throughout. In addition, there are two other intervals in the unit. The lower one is twenty feet thick, and consists of a band of altered intermediate to basic volcanics between two thin layers of white claystone. The upper one is also twenty feet thick and consists entirely of white claystone. X-Ray analysis showed this to consist of chlorite with minor calcite and silica.

Environment and provenance: The sediments were deposited under shallow, marginal, probably fresh water reducing conditions. The provenance for the basal subgreywacke is dominantly volcanic. The overlying sediments are mainly from a sedimentary source, with a minor granitic source suggested by accessory amounts of plagioclase and muscovite.

Unit M6 (Plate 1A)

Characteristics: This unit extends from 950' to 1440'; it consists of four thin coal seams, with partings of fine to medium-grained volcanic subgreywacke, and sideritic carbonaceous siltstone grading to protoquartzite. Although fluctuations of grain-size occur, there is, as in the unit above, an overall fining upwards. A series of thin very altered intermediate to basic intrusions are also present in this unit.

Boundary criteria: The lower boundary has been placed above the coal seam at the top of the underlying unit.

Environment and provenance: The sediments were deposited under shallow, marginal, probably fresh water, mainly reducing conditions. The subgreywacke has a dominantly volcanic provenance, and the finer sediments a mainly sedimentary one, with minor granitic source.

Unit M7 (Plate 1A)

Characteristics: This unit extends from 1440' to 1600'; it consists of a volcanic sub-greywacke which is pebbly in parts with intervals of carbonaceous claystone and siltstone and two thin seams of coal and shale at the top.

Boundary criteria: The lower boundary is well marked by an increase in both resistivity and radiation intensity reflecting the lithological change to the volcanics of the unit below.

Environment and provenance: The sediments were laid down under shallow, marginal, probably fresh water and mainly reducing conditions. The provenance is mainly volcanic with subsidiary sedimentary and minor granitic ones.

Unit M8 (Plate 1A and B)

Characteristics: This unit extends from 1600' to 1710', and is an altered intermediate volcanic. The lower half of the unit is less altered and has been tentatively identified as a syenite containing K felspar, pyroxene, biotite and chlorite.

Boundary criteria: The lower boundary is marked by a sharp decrease in resistivity and radiation intensity reflecting a lithological change to the sediments below.

Unit M9 (Plate 1B)

Characteristics: This unit extends from 1710' to 2090'; it consists of a sequence of coal seams with partings of volcanic lithic greywacke grading to carbonaceous sideritic claystone and siltstone. The lithic greywacke has clear "volcanic" quartz with straight extinction, and is rich in "volcanic" chert, and altered sedimentary rock fragments. It also contains pyritic carbonaceous material.

Boundary criteria: The lower boundary is marked by a lithological change to the lithic sandstone of the unit below and on the wire-line logs by an increase in resistivity and decrease in radiation intensity.

Environment and provenance: The sediments were deposited under shallow, marginal, probably fresh water, mainly reducing conditions. The provenance is mainly volcanic with subsidiary sedimentary and minor granitic ones.

Unit M10-14

This sequence extends from 2080' to 3390'. The Company equated it to the Maitland Group and recognised the Mulbring and Branxton sub-groups.

Unit M10 (Plate 1B)

Characteristics: This unit extends from 2090' to 2130'; it consists of a fine-grained protoquartzite grading to siltstone and contains carbonaceous material and siderite and dawsonite cement.

Boundary criteria: The lower boundary is marked on the wire line logs by a decrease in resistivity and an increase in radiation intensity corresponding to a lithological change to the claystone below.

Environment and provenance: The sediments were deposited in a shallow water, marginal, marine environment under somewhat reducing conditions. The provenance is mainly sedimentary with a minor granitic source suggested by accessory amounts of plagioclase and muscovite.

Unit M11 (Plate 1B)

Characteristics: This unit extends from 2130' to 2160'; it consists of interbedded, carbonaceous, sideritic, pyritic, siltstone and claystone.

Boundary criteria: The lower boundary is marked on the wire-line logs by a decrease in radiation intensity and a decrease in resistivity corresponding to a lithological change to the siltstone below.

Environment and provenance: The sediments were deposited in a quiet, marginal marine environment under reducing conditions. The provenance is mainly sedimentary with a minor granitic source suggested by accessory amounts of plagioclase and sericite.

Unit M12 (Plate 1B)

Characteristics: This unit extends from 2160' to 2240'; and consists of siltstone containing carbonaceous material, pyrite, and dawsonite and siderite cements.

Boundary criteria: The lower boundary is marked by a sharp increase in resistivity corresponding to a lithological change to the sandstone below.

Environment and provenance: The sediments were deposited in a shallow, quiet, marginal marine environment under reducing conditions. The provenance is mainly sedimentary.

Unit M13 (Plate 1B)

Characteristics: This unit extends from 2240' to 2696'; it consists of siltstone grading in parts to very fine-grained protoquartzite with siderite, dawsonite and calcite cements in varying proportions. Small amounts of carbonaceous material, pyrite, quartz and chert pebbles and volcanic rock fragments occur throughout. Bryozoa were observed in the cuttings near the top of the unit.

Boundary criteria: The lower boundary is marked on the wire-line logs by an increase in resistivity, and a decrease in radiation intensity corresponding to a lithological change to the sandier unit below.

Environment and provenance: A shallow water, marginal, quiet marine environment is postulated for the deposition of the sediments and the provenance is mainly sedimentary with a subsidiary granitic source suggested by accessory amounts of plagioclase, muscovite and zircon, and there was also a minor volcanic source.

Unit M14 (Plate 1B)

Characteristics: This unit extends from 2695' to 3390'; it consists of subgreywacke and protoquartzite grading in parts to siltstone and claystone. Carbonaceous material and coal fragments decrease upwards. The base of the unit is pebbly (quartz and chert), and scattered pebbles, volcanic rock fragments and pyrite are present throughout. Siderite, calcite and dawsonite cements are also found throughout, but silica is rare. Sedimentary rock fragments are common in the bottom 200' and rare glauconite was also observed. Shell fragments were also noted in the thin sections.

Boundary criteria: The lower boundary is marked on the wire line logs by a decrease in resistivity.

Environment and provenance: The sediments were deposited under shallow water, marginal marine conditions probably with some gentle current action. The provenance is mainly sedimentary, with a subsidiary granitic source, suggested by accessory amounts of plagioclase, muscovite and zircon, and a minor volcanic source.

Unit M15-17

This unit extends from 3390' to 3780'. The Company has equated it to the Muswellbrook Coal Measures.

Unit M15 (Plate 1B)

Characteristics: This unit extends from 3390' to 3630'; it consists of a sandy petromict conglomerate at the base, above which is a series of six thin coal seams with partings of sandy carbonaceous siltstone followed by a medium grained subgreywacke which becomes very fine-grained toward the top, and contains silty carbonaceous laminae. There is a thin coal seam about 40' from the top of the unit. The quartz in the sandstone is clear, with straight extinction. Plagioclase varies from accessory amounts to 15% and there are volcanic and sedimentary rock fragments and pyritic carbonaceous material. The cements are siderite, dawsonite, and calcite. Metaquartzite fragments were observed in thin sections from Core 4.

Boundary criteria: The lower boundary of the unit is marked on the wire-line logs by a decrease in resistivity corresponding to a change to the fine-grained sandstone of the unit below.

Environment and provenance: A shallow, marginal fresh water environment is postulated, with current action at the start of deposition followed by the development of the coals, and culminating in the deposition of the subgreywacke under quiet conditions, but with intermittent current action (Core 4 Plate 2A). The provenance for the basal conglomerate is sedimentary with minor volcanic and for the subgreywacke, volcanic and sedimentary with minor granitic suggested by accessory zircon and muscovite.

Unit M16 (Plate 1B)

Characteristics: This unit extends from 3630' to 3670'; it consists of a fine-grained protoquartzite which contains sedimentary rock fragments and minor carbonaceous material, calcite and silica cements, and lenses of sideritic sandstone. Rare bryozoa were observed in the cuttings. This unit is lithologically similar to L5 in Loder (A.O.G.) No. 1 Well, (Nicholas 1968).

Boundary criteria: The lower boundary is marked on the wire-line logs by an increase in resistivity reflecting a lithological change to the sandy conglomerate below.

Environment and provenance: A shallow, marginal marine environment is postulated for this unit, and a mainly sedimentary provenance, with subsidiary granitic suggested by accessory amounts of plagioclase and sericite.

Unit M17 (Plate 1B and C)

Characteristics: This unit extends from 3670' to 3780'. The rock types described in M15 are also found in this unit, although there is no development of coal seams. The sequence consists of a sandy conglomerate at the base, above which is a thin band of hard pyritic, black shale followed by medium-grained subgreywacke as in M15 becoming very fine-grained toward the top of the unit. At the top there is ten feet of sandy conglomerate.

Boundary criteria: The lower boundary of the unit is marked on the wire-line logs by a sharp decrease in radiation intensity and resistivity reflecting a change to the volcanics below.

Unit M18

This unit extends from 3780' to 3876' (T.D.); it consists of an altered intermediate to basic volcanic with bands of greyish-red clay, and has been equated by the Company with the Allandale Formation of the Dalwood Group.

CONCLUSIONS

Degree of agreement with Well Completion Report.

A comparison between unit boundaries chosen in this study and the stratigraphic subdivisions set out in the Well Completion Report (A.O.G. 1967) is given in Fig. 2., and it can be seen that there is broad agreement with regard to the major stratigraphic boundaries.

Summary of new data

The total section consists of 3780' of sediments underlain by 96' of intermediate to basic volcanics. The sediments have been divided into seventeen lithological units representing two phases of dominantly fresh water deposition separated by a marine sequence.

The thin, marine interval (M16) within the lower coal measure sequence was not recognised by the Company, and is of interest because of its lithological affinities to the Upper Farley in Loder (A.O.G.) No. 1, (Nicholas 1968). This study has also indicated a closer affinity between the sandstones and conglomerates of the lower coal measure sequence with those found in the Greta Coal Measures in Loder (A.O.G.) No. 1, than to the sediments reported from Muswellbrook (F.W. Booker 1960).

"It consists of a monotonous alternation of greywacke, siltstone, mudstone, shale....."

The acid volcanics reported by the Company in the Tomago Coal Measures have been identified as intermediate to basic in this study. The white claystone at 580', and the altered volcanics at 1600' were identified as dolomite by the Company.

Possible influence of new data on hydrocarbon prospects.

The tightness of the sediments has been confirmed by this study, and this, in addition to the fact that there were no indications of oil or gas makes the Martindale Anticline a poor prospect for petroleum exploration.

REFERENCES

A.O.G.	1967	Martindale No. 1 and 1A Well Completion Report (unpubl.)
FOLK, R.L.	1965	Petrology of Sedimentary Rocks (Hemphill's, Austin, Texas. 2nd ed.)
PETTIJOHN, F.J.	1957	Sedimentary Rocks (Harper N.Y.)
NICHOLAS, E	1968	Petrological Study of Loder (A.O.G.) No. 1 Well Sydney Basin, N.S.W. B.M.R. Record No. 1968/130.
BOOKER, F.W.	1960	Studies in Permian Sedimentation in the Sydney Basin. N.S.W. Dept. of Mines Tech. Rep. vol. 5 pp 10-62.

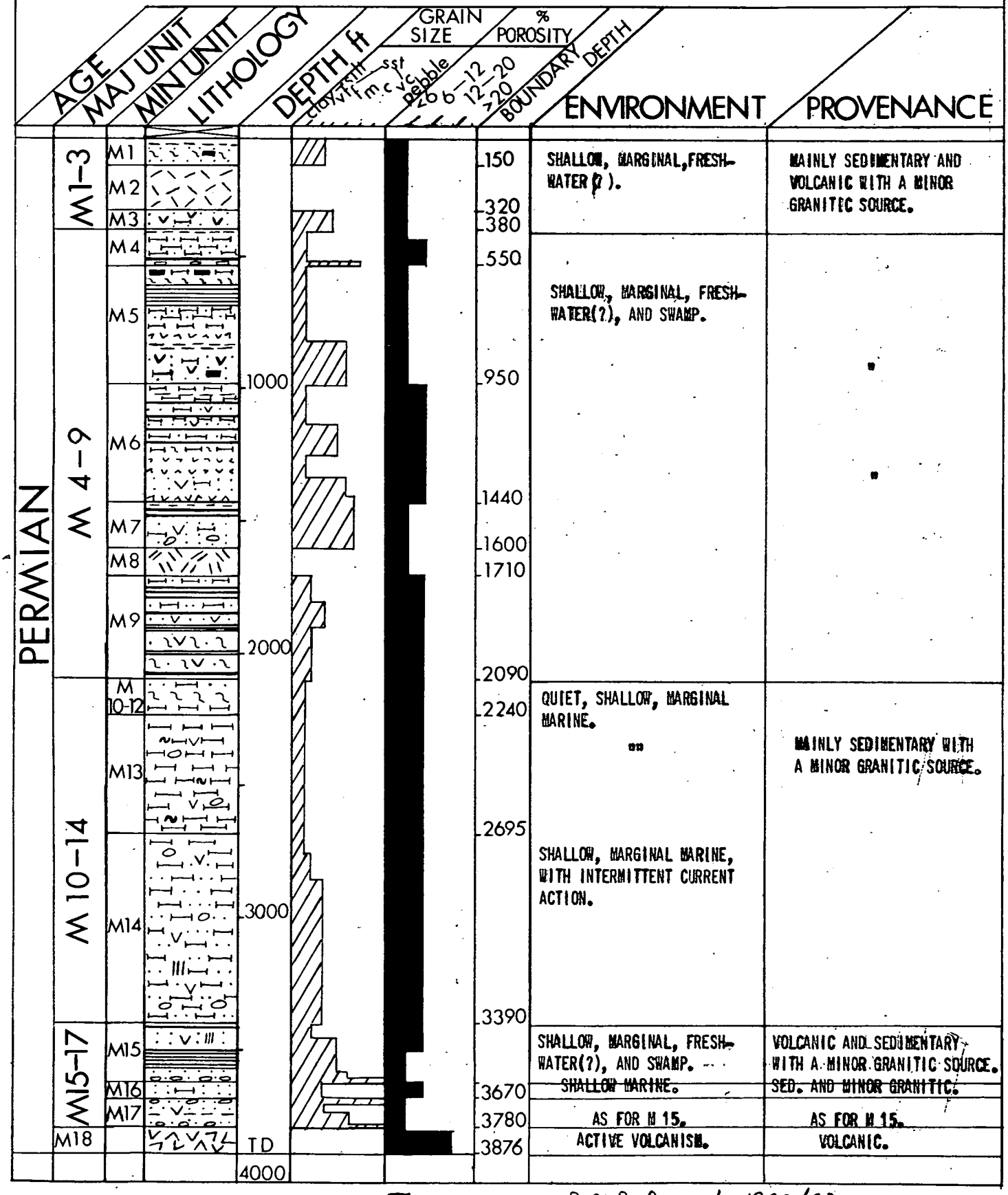
PLATES

Plate 1A:	Petrographic Well Log 0-1700'
Plate 1B:	" " " 1700'-3700'
Plate 1C:	" " " 3700'-3876'
Plate 2A:	Petrographic Core Log Cores 1, 4, 5,

FIG 1

MARTINDALE(AOG)No1A

SUMMARY OF PETROLOGICAL RESULTS



To accompany B.M.R. Record 1969/62

FIG 2

COMPARISON OF BMR UNITS WITH COMPANY INTERPRETATION

BMR UNITS		BOUNDARY DEPTHS (feet)	COMPANY (AOG 1967)		
MAJOR	MINOR		FORM'N	GROUP	AGE
M1-3	M1	150	NEWCASTLE	UPPER COAL MEASURES	PERMIAN
	M2	320			
	M3	380	380		
M4-9	M4	550	TOMAGO		
	M5	950			
	M6	1440			
	M7	1600			
	M8	1710			
	M9	2090	2127		
M10-14	M10-12	2240	MULBRING	MAITLAND	
	M13	2695	2728		
	M14	3390	BRANXTON		
			3426		
M15-17	M15		MUSWELLBR'K	LOWER COAL MEASURES	
	M16	3670			
	M17	3780	3774		
M18	M18	3876 TD	ALLANDALE	DALWOOD	

To accompany B.M.R. Record 1969/62

WELL NAME, No. MARTINDALE(A.O.G.)No1a ELEVATION (A.S.L.) SAMPLE STORAGE
OPERATING Co. A.O.G. : Ground Level 648 ft. : B.M.R., Canberra
WELL LOCATION : K.B. Datum 657 ft.
Lat. 32° 30' 48" S. Long. 150° 37' 00" E.
Basin SYDNEY
State N.S.W.
Tenement No. P.E.L. 103
1:250.000 Sheet No. S I 56 1

HYDROCARBON SYMBOLS
- Show of oil
- Trace of oil
- Show of gas
- Trace of gas
- Fluorescence

MISCELLANEOUS
- Interval and Number of Formation Test
- No sample available from interval

0 — 100 — 200 ft

PETROGRAPHIC WELL LOG
MARTINDALE(A.O.G) No1a.

Geology by. E. Nicholas & G. Parker

- Iron oxides
- Pyrite
- Sed lithics
- Siderite
- Dawsonite
- Silica

LITHOLOGICAL SYMBOLS
- Breccia to conglomerate
- Quartz sand, sandstone
- Siltstone
- Claystone
- Limestone
- Dolomite
- Coal
- Shale and mudstone
- Calcirudite
- Calcarenite
- Calcilutite

Volcanics
- Undiff
- Interm
- Basic

MINERAL ABBREVIATIONS

Plate 1A

Gl	glauconite
Bi	Biotite
Orth	Orthoclase
Plag	Plagioclase
Musc	Muscovite
Zn	Zircon
Seric	Sericite
Micr	Microcline
Ca	Calcite
Sd	Siderite
Da	Dawsonite
Si	Silica
Py	Pyrite

DEPTH (feet) from datum (Plant fragments)

FOSSILS R - rare C - common A - abundant X - present

CARBONATE % LOG (Dil. HCl Test) Calcite type — (1 min reaction) Dolomite type --- (10 min reaction) Approx. Wt %

GRAIN SIZE (Wentworth Scale) Estim. size range & mode — Sands: Clay - Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt - size)

LITHOLOGIES AND % OF CUTTINGS

THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS

(Description ③ refers to lithological pattern ③ at corresponding depth)

1 DARK GREY CLAYSTONE. CARBONACEOUS. MICACEOUS.
2. SHALE. VARIABLE CONTENT OF CARBONACEOUS MATERIAL. RARE PYRITE.
3. SANDSTONE. MEDIUM GREY. CARBONACEOUS MATERIAL IN LAMINAE AND FINELY SCATTERED.
4. SILTY CLAYSTONE. MEDIUM LIGHT GREY. CARBONACEOUS MATERIAL IN STREAKS AND SCATTERED THROUGHOUT. VEINS OF CALCITE. GRADES TO FINES SANDSTONE.
5. SANDSTONE. LIGHT GREY. GREY CHERT. SIDERITE. IRREGULARLY DISTRIBUTED CARBONACEOUS MATERIAL. WELL INDURATED.
6. CLAYSTONE. WHITE. SOFT. VERY SPARSE CARBONACEOUS MATERIAL.
7. VOLCANIC. OLIVE BLACK. WHITE CALCITIC PATCHES.
8. SANDSTONE. LIGHT GREY. PYRITIC CARBONACEOUS FRAGMENTS. MICACEOUS. CARBONATE CEMENT.
9. DARK GREY CARBONACEOUS SHALE.
10. SILTSTONE. DARK GREY. MICACEOUS. FRAGMENTS OF COAL AND FINELY DISPERSED CARBONACEOUS MATERIAL. GRADES TO SHALE.
11. SANDY CONGLOMERATE. MEDIUM LIGHT GREY AND WHITE. RICH IN BLACK, GREEN, AND GREY CHERT. BRIGHT COAL FRAGMENTS.
12. SILTSTONE. MEDIUM DARK GREY. SIMILAR TO 10 BUT WITH INCREASE IN CARBONACEOUS MATERIAL (PLANT FRAGMENTS).
13. MEDIUM GREY SHALE. NONE CARBONACEOUS AND CARBONACEOUS GRADING TO COAL.
14. CLAYSTONE. LIGHT GREY TO WHITE. CONTAINS CARBONATE.
15. SILTSTONE. MEDIUM TO MEDIUM DARK GREY. CARBONACEOUS LAMINAE.
16. SANDSTONE. CONTAINS GREEN CHERT AND BRIGHT COAL FRAGMENTS. SIDERITE AND CALCITE CEMENTS.
17. SHALE. MEDIUM TO MEDIUM DARK GREY. SCATTERED PYRITE. VERY CARBONACEOUS AND GRADING TO VITREOUS COAL. CALCITE CEMENT.
18. SANDSTONE. DARK GREY. CARBONACEOUS. GRADES TO 15.
19. SANDSTONE. MEDIUM DARK GREY. RICH IN VOLCANIC ROCK FRAGMENTS.
20. SANDSTONE. MEDIUM LIGHT GREY. WITH GREEN CHERT AND CARBONACEOUS MATERIAL.
21. SHALE. MEDIUM GREY. FINELY DISPERSED CARBONACEOUS MATERIAL.
22. SANDSTONE. LIGHT GREY. CONTAINS GREEN GREY AND ORANGE CHERT, CARBONACEOUS MATERIAL AND SIDERITE CEMENT.
23. SILTSTONE. VERY CARBONACEOUS WITH COAL LAMINAE. PYRITE. MICACEOUS.
24. SILTSTONE. GRADES TO VERY FINE SANDSTONE. MODERATELY TO VERY CARBONACEOUS.
25. SHALE. DARK GREY. VERY CARBONACEOUS AND PYRITIC.
26. SANDSTONE. VARIABLE CONTENT OF CARBONACEOUS MATERIAL SCATTERED AND IN LAMINAE. SIDERITE CEMENT.
27. CLAYSTONE. CARBONACEOUS.
28. SANDSTONE. CONTAINS RED CHERT AND MICA. VARIABLE CONTENT OF CARBONACEOUS MATERIAL. GRADES TO SILTSTONE.
29. SANDSTONE. WHITE TO LIGHT GREY. CONTAINS RED AND GREEN CHERT.
30. SILTSTONE. CARBONACEOUS . PYRITIC.
31. CLAYSTONE. CARBONACEOUS. GRADES TO COAL.
32. VOLCANICS.
33. SANDSTONE. LIGHT GREY. SPARSE COAL FRAGMENTS.
34. VOLCANICS.
35. VOLCANICS. WHITE TO LIGHT GREY.

PHOSPHATE CONTENT (Molybdate Test): Nil; Trace, Low, Med., High

INTERPRETED POROSITY Cores - Cuttings: Slight < 6%, Poor 6-12%, Mod 12-20%, Good > 20%

SONIC LOG — Interval Transit Time Microseconds per foot Spacing 3 feet (140 — 40)

HYDROCARBONS CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m (0 — 10 — 50 — 500)

GAMMA RAY LOG — Radiation intensity increases → (0 — 125)

KEY MINERALS: Clasts, Cement, Matrix

Formation Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY — Rock Name (after Pettijohn, 1957)

Depth	Key Minerals	Description of Interpreted Lithology
	Musc Ca; Plag Zn Ca; Musc Sd	DARK GREY SHALE WITH COAL LAMINAE AND FINELY DISPERSED CARBONACEOUS MATERIAL, PYRITIC LAMINAE AND FINE VEINS OF CALCITE. SHALE AS ABOVE, INTERBEDDED WITH A VERY CALCITIC SUBGREYWACKE. SILTY CLAYSTONE. CARBONACEOUS MATERIAL IN STREAKS AND FINELY DISPERSED. FINE CALCITIC VEINS AND SOME SIDERITE CEMENT.
160		LIGHT GREY VOLCANIC SUBGREYWACKE.
		ALTERED BASIC VOLCANIC. OLIVE-BLACK. CONTAINS HORNEBLENDE MINOR PYROXENE AND BIOTITE, ALTERED OLIVINE(?) AND ABUNDANT CHLORITE.
320	Musc Ca; Plag Py Sd	VOLCANIC SUBGREYWACKE, AS ABOVE.
380	Musc Py Ca Sd	DARK GREY CARBONACEOUS SHALE.
	Plag Seric Py Ca Sd Da	SILTSTONE. BLACK VITREOUS COAL.
550	Plag Zn; Musc Plag Ca Sd	SANDY CONGLOMERATE. BLACK GREEN AND GREY CHERT. MINOR SAND-SIZED QUARTZ AND CARBONACEOUS MATERIAL AND VERY MINOR ALTERED PLAGIOCLASE FELDSPAR. SIDERITIC SILTSTONE, CARBONACEOUS, AND CARBONACEOUS SHALE GRADING TO COAL. PALE GREY TO WHITE CLAYSTONE, MAINLY CHLORITE WITH MINOR CALCITE AND SILICA. COAL SEAMS WITH PARTINGS OF PROTOQUARTZITE.
		COAL SEAMS WITH PARTINGS OF SILTY CARBONACEOUS SHALE.
		CARBONACEOUS SILTSTONE GRADING TO FINE SANDSTONE.
	Musc Py Ca Da Sd Si	PALE GREY TO WHITE CLAYSTONE AND INTERMEDIATE TO BASIC VOLCANICS. INTERBEDDED CARBONACEOUS SHALE AND SILTSTONE WITH THIN COAL SEAMS.
	Py Sd Ca Da	VOLCANIC SUBGREYWACKE. LIGHT GREY. INTERBEDDED IN PARTS WITH VERY CARBONACEOUS PYRITIC SILTSTONE.
950	Plag Py Sd; Py	SIDERITIC SILTSTONE. CARBONACEOUS. GRADING IN PARTS TO FINE SANDSTONE AND TO PYRITIC CARBONACEOUS SHALE.
	Plag Musc Seric Ca Sd	COAL. DULL AND BRIGHT BITUMINOUS. SIDERITIC SUBGREYWACKE AND CARBONACEOUS CLAYSTONE.
	Plag Micr Ca Sd	SIDERITIC CARBONACEOUS SILTSTONE GRADING IN PARTS TO FINE AND MEDIUM GRAINED SUBGREYWACKE, WITH VOLCANIC CHERT FRAGMENTS. MEDIUM GRAINED SUBGREYWACKE RICH IN VOLCANIC CHERT FRAGMENTS.
	Plag Py Seric Ca Sd	PYRITIC CARBONACEOUS SILTSTONE GRADING TO FINE SANDSTONE.
	Plag Musc Ca Sd	BRIGHT BITUMINOUS COAL. SILTY CARBONACEOUS PROTOQUARTZITE GRADING TO SILTY CARBONACEOUS CLAYSTONE.
	Plag Da	INTERMEDIATE TO BASIC INTRUSIVE, AND SUBGREYWACKE RICH IN VOLCANIC CHERT FRAGMENTS, AS ABOVE, AND SEDIMENTARY ROCK FRAGMENTS. SILTY IN PARTS.
	Plag Musc Zn Da Ca Sd	
1440		VERY ALTERED INTERMEDIATE TO BASIC VOLCANIC WITH CALCITE IN VEINS AND VUGHS, ALTERING TO CLAYSTONE AS AT 600ft. CARBONACEOUS SHALE AND THIN COAL SEAMS.
	Plag Musc Da Ca Sd	SUBGREYWACKE AS ABOVE, PEBBLY IN PARTS AND WITH INTERVALS OF CARBONACEOUS CLAYSTONE AND SILTSTONE.
1600		ALTERED VOLCANIC, CONTAINING K. FELDSPAR AND CLAY MINERALS
		VOLCANIC, LESS ALTERED THAN ABOVE, CONTAINING K. FELDSPAR, PYROXENE, BIOTITE, AND CHLORITE. SYENITE?

B.M.R. UNITS: BOUNDARY DEPTHS (feet); MINOR UNIT; MAJOR UNIT

COMPANY INTERPRETATION: FORMATION; GROUP; AGE

M1 — M2 — M3 — M4 — M5 — M6 — M7 — M8 — M1-3 — M4-9

NEWCASTLE COAL MEASURES — TOMAGO COAL MEASURES — UPPER COAL MEASURES — PERMIAN

BMR Petroleum Exploration January 1968

To accompany B.M.R Record 1969/62

x AUS - I - 60A

DEPTH (feet) from datum — Bruyzoa, Shell Fragments

FOSSILS — R - rare C - common A - abundant X - present

CARBONATE % LOG — (Dil. HCl Test) — Calcite type — (1 min. reaction) — Dolomite type — (10 min. reaction) — Approx. Wt % 20 40 60 80 100

GRAIN SIZE (Wentworth Scale) — Estim. size range & mode — Sands — Clay - Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt - size) — 50%

LITHOLOGIES AND % OF CUTTINGS

THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS

(Description ③ refers to lithological pattern ③ at corresponding depth)

35. SANDSTONE. LIGHT GREY. CALCITE AND CARBONACEOUS MATERIAL.
37. CARBONACEOUS SILTSTONE.

38. SANDSTONE. LIGHT GREY. CARBONACEOUS MATERIAL. SIDERITE CEMENT.

39. CLAYSTONE. LIGHT GREY. CONTAINS SOME CARBONACEOUS MATERIAL AND SIDERITE.

40. SANDSTONE, LIGHT GREY. CONTAINS SIDERITE.

41. SANDSTONE. LIGHT GREY. CONTAINS CARBONACEOUS MATERIAL AND CALCITE.
42. SILTSTONE. DARK GREY. CARBONACEOUS MATERIAL AND CARBONATE CEMENTS. GRADES TO 43. SANDSTONE. LIGHT GREY. CONTAINS CARBONACEOUS MATERIAL AND MICA.
44. CLAYSTONE. CARBONACEOUS AND PYRITIC.
45. SILTSTONE. GRADES TO VERY FINE SANDSTONE.

46. SANDSTONE. LIGHT TO MEDIUM GREY. SPARSE CARBONACEOUS MATERIAL AND PYRITE.

47. SANDSTONE. LIGHT TO MEDIUM GREY. CONTAINS SPARSE CARBONACEOUS MATERIAL AND CARBONATE CEMENT.

48. SANDSTONE. LIGHT GREY. CONTAINS PEBBLES, GREEN CHERT, PYRITE.

49. SANDSTONE. LIGHT GREY. SPARSE CARBONACEOUS MATERIAL.

VOLCANICS (CAVINGS).

50. SANDSTONE. LIGHT TO MEDIUM GREY. SPARSE CARBONACEOUS MATERIAL. GLAUCONITE.

51. MEDIUM DARK GREY SANDSTONE. COMMON PYRITE. MICA. COMMON BRIGHT BLACK COAL FRAGMENTS AND STREAKS. SIDERITE.

52. SANDSTONE. VERY LIGHT GREY . GREY AND GREEN CHERT. BRIGHT COAL FRAGMENTS. SIDERITE.

53. SANDSTONE. MEDIUM LIGHT GREY. COARSE GRAINED AND PEBBLY.
54. SANDSTONE. LIGHT GREY. GREEN, GREY, AND RARE RED CHERT. PATCHY, AND FINELY DISPERSED CARBONACEOUS MATERIAL AND PYRITE. SIDERITE.

PHOSPHATE CONTENT (Molybdate Test) — Nil, Trace, Low, Mod, High

INTERPRETED POROSITY Cores - Cuttings — Slight < 6%, Poor 6-12%, Mod. 12-20%, Good > 20%

SONIC LOG — INTERVAL TRANSIT TIME Microseconds per foot Spacing 5 feet — 190 ← 140 — 90 ← 40

HYDROCARBONS CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m — 0 10 50 500 — 1.0 — 1.2

GAMMA RAY LOG — Radiation intensity increases →

KEY MINERALS — Clasts — Cement, Matrix

DESCRIPTION OF INTERPRETED LITHOLOGY

Formation ← Test Data — Rock Name (after Pettijohn, 1957)

SANDY CARBONACEOUS SILTSTONE GRADING TO CARBONACEOUS SHALE AND COAL.
COAL SEAMS WITH PARTINGS OF VOLCANIC LITHIC GREYWACKE AND CARBONACEOUS SILTSTONE.

VOLCANIC LITHIC GREYWACKE.

COAL SEAMS WITH PARTINGS OF LITHIC GREYWACKE AND CARBONACEOUS SIDERITIC CLAYSTONE.

VOLCANIC LITHIC GREYWACKE GRADING TO CARBONACEOUS CLAYSTONE.

SIDERITIC PROTOQUARTZITE GRADING TO SIDERITIC SILTSTONE.

INTERBEDDED CARBONACEOUS SIDERITIC SILTSTONE AND CLAYSTONE

CARBONACEOUS SILTSTONE.

SIDERITIC CARBONACEOUS SILTSTONE, GRADING IN PARTS TO VERY FINE GRAINED PROTOQUARTZITE WITH CALCITE, DAWSONITE AND SIDERITE CEMENTS IN VARYING PROPORTIONS.

SUBGREYWACKE AND PROTOQUARTZITE GRADING TO CARBONACEOUS SILTSTONE AND CLAYSTONE. UNIT BECOMES LESS SANDY UPWARDS.

SUBGREYWACKE, RICH IN VOLCANIC AND SEDIMENTARY ROCK FRAGMENTS. CONTAINS PYRITIC CARBONACEOUSS MATERIAL.
THIN COAL SEAM.
SUBGREYWACKE, WITH VOLCANIC AND SEDIMENTARY ROCK FRAGMENTS AND SILTSTONE LAMINAE

SERIES OF THIN COAL SEAMS WITH PARTINGS OF SANDY CARBONACEOUS SILTSTONE.

SANDY PETROMICT CONGLOMERATE. MAINLY QUARTZ PEBBLES, WITH MINOR CHERT AND VOLCANIC. DAWSONITE AND CALCITE CEMENT.

PROTOQUARTZITE WITH SEDIMENTARY ROCK FRAGMENTS AND RARE BRYOZOA.
SANDY CONGLOMERATE, AS ABOVE.
FINE GRAINED SUBGREYWACKE, AS ABOVE.

B.M.R. UNITS — BOUNDARY DEPTHS (feet) — MINOR UNIT — MAJOR UNIT

1710 — M 9 — M4-9
2090 — M 10 — M10-14
2130 — M 11
2160 — M 12
2210
2695 — M 13
3390 — M 14 — M15-17
3630 — M 15
3670 — M 16

COMPANY INTERPRETATION — FORMATION — GROUP — AGE

TOMAGO COAL MEASURES — UPPER COAL MEASURES — SUB-GROUP — BRANXTON SUB-GROUP — MUSWELLBROOK C.M. — MAITLAND GROUP — MULBRING SUB-GROUP — PERMIAN

B.M.R. Petroleum Exploration January 1968.

To accompany B.M.R. Record 1969/62

X AUS-1-608

DEPTH (feet) from datum

FOSSILS
R - rare C - common
A - abundant X - present

CARBONATE % LOG
(Dil. HCl Test)
Calcite type — (1 min. reaction)
Dolomite type --- (10 min. reaction)
Approx. Wt. %

GRAIN SIZE (Wentworth Scale)
Estim. size range & mode
Sands
Clay - Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt - size)
Trace < 5%, Poor 5-10%, Fair 10-15%, Good 15-20%, Excel. > 20%

LITHOLOGIES AND % OF CUTTINGS
50%

THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS
(Description ③ refers to lithological pattern ③ at corresponding depth)

52, SANDSTONE, AS ABOVE.
54, SHALE, HARD, CALCITIC, PYRITIC, CARBONACEOUS.
53, SANDY CONGLOMERATE, AS ABOVE.
55, GREENISH RED-GREY VOLCANICS.

PHOSPHATE CONTENT (Molybdate Test)
Nil, Trace, Low, Med, High

INTERPRETED POROSITY
Cores - Cuttings
Slight < 5%, Poor 5-12%, Med 12-20%, Good > 20%

SONIC LOG
INTERVAL TRANSIT TIME
Microseconds per foot Spacing 3 feet
90 190

HYDROCARBONS
CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY
Ohms m²/m

GAMMA RAY LOG
Radiation intensity increases →

KEY MINERALS
Clasts, Cement, Matrix
Plag Py Sd
Musc Da
Py Da
Ca

Formation
← Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY
Rock Name (after Pettijohn, 1957)

INTERBEDDED FINE AND MEDIUM GRAINED SUBGREYWACKE, AS ABOVE.
CARBONACEOUS PYRITIC SHALE.
SANDY CONGLOMERATE, AS ABOVE.
ALTERED INTERMEDIATE TO BASIC VOLCANIC WITH BANDS OF GREY (SILL-BED CLAY.

B.M.R. UNITS
BOUNDARY DEPTHS (feet)
MINOR UNIT
MAJOR UNIT

3780 — M 17
3876 — M 18

COMPANY INTERPRETATION
FORMATION: ALLAN-DALE, KOOL-WOOD
GROUP
AGE: PERMIAN

3800
3814
3876
3900

B.M.R. Petroleum Exploration January 1968.

To accompany B.M.R. Record 1969/62

x AUS - 1 - 608

WELL NAME, No.: Martindale (AOG) No1
OPERATING Co.: A.O.G.
WELL LOCATION
Lat.: 32° 30' 48"S. Long.: 150° 37' 00"E.
Basin: Sydney
State: N.S.W.
Tenement No. P.E.L. 103
1:250,000 Sheet No. I 561

ELEVATION (A.S.L.)
: Ground Level 648 ft.
: K.B. Datum 657 ft.

SAMPLE STORAGE
B.M.R., Canberra

PETROGRAPHIC CORE LOG
MARTINDALE (A.O.G.) No. 1a

Geology by E. Nicholas.

Plate 2A

Laminae: >5cm; 1-5cm; ½-1cm; ⅒-½cm; <⅒cm
Cross bedding: Set >1cm; Set <1cm; Graded bedding; Wavy bedding

Interval - ft: 6540'6" / 6541'6"
Core not recovered
Position of lost core not known

Porosity (estimated): S - Slight < 6%; P - Poor 6-12%; M - Medium 12-12%; G - Good > 20%

Abundance (estimated): R - Rare < 1%; C - Common 1-3%; A - Abundant > 3%

Siderite; Dawsonite; Iron Oxide

Breccia to conglomerate; Quartz sand, sandstone; Siltstone; Claystone; Limestone; Dolomite

Coal; Shale and mudstone

Calcirudite; Calcarenite; Calcilutite

Symbols used to designate carbonate minerals (Calcite, Dolomite etc) in the "Essential Components" column

CORRELATION

AGE: PERMIAN
GROUP: UCM; LCM
FORMATION: NCM; MUSWELLBROOK C.M.
B.M.R. UNITS: M1-3; M15-17; M15; M18; DALWOOD; ALLANDALE

GENERALIZED DESCRIPTION

CORE Nº RECOVERY FOOTAGES

LITHOLOGY

DESCRIPTION — GENERALIZED ROCK NAME

COLOUR — Rock Colour Chart GSA 1963

SEDIMENTARY STRUCTURE (symbols)

DIP & TECTONIC STRUCTURE

DETAILED DESCRIPTION

DEPTH OF SAMPLE SECTIONED, ANALYZED

SPECIFIC ROCK NAME (After Pettijohn 1957)

POROSITY % where measured — HIGH >15%; GOOD 5-15%; MED 1-5%; POOR <1%

PERMEABILITY Millidarcys — VERTICAL; HORIZONTAL

ROUNDNESS — ANGULAR; SUB-ANG.; SUB-ROUND; ROUND

SORTING — POOR; MOD.; GOOD

GRAIN - SIZE (Wentworth Scale) Estim size Range & Mode

SANDS — CLAY - SILT; VERY FINE; FINE; MEDIUM; COARSE; VERY COARSE; PEBBLES

THIN - SECTION ANALYSIS

% OF ESSENTIAL COMPONENTS — CROSS HATCHED IF MATERIAL CLEARLY PRESENT AS CEMENT AND / OR MATRIX; POROSITY SHOWN AS BLANK

Matrix and/or Cement Estim. % of Total Rock — CLAY-UNDIFF; KAOLIN Gp

Cement Symbols See Legend

ACCESSORY MINERALS Estim. R-C-A or Measured % Total Rock

"Dark Minerals" — TOTAL "DARK"; Carbonaceous; Pyrite; Zircon

"Light Mins" — Sericite; Muscovite; Plagioclase

Opt. +ve/-ve; Extinction

MATURITY INDEX

NOTES (provenance, environment of deposition, diagenesis, palaeontology etc.)

Depth of sample sectioned, analyzed	Specific rock name	Porosity	Permeability	Roundness	Sorting	Grain-size	Thin-section analysis	Accessory minerals	Notes
324'-325'2"	Volcanic subgreywacke	NIL	NIL				R		Sedimentary and volcanic provenance. Shallow quiet, near-shore deposition. Abundant carbonate cement.
3447'-8"	Subgreywacke						R	R	Sedimentary and volcanic provenance.
3448'6"-11" / 3449'-4½"	Subgreywacke	NIL	NIL				A	R C	Deposition in near-shore Shallow deltaic environment with intermittent current action.
3452'-53'3"	Subgreywacke	NIL	NIL				C	C C	Shell fragments.
3870'-76'6"	Altered interm-basic flow	14	NIL	NIL					Volcanic flow. Very altered felspar, minor altered pyroxene. Common haematite and magnetite.

To accompany B.M.R. Record 1961/62