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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1966/155

MULGA NO.1. WELL AND ITS STRATIGRAPHIC IMPLICATIONS, GEORGINA BASIN. N.T.

by

R.A.H. Nichols

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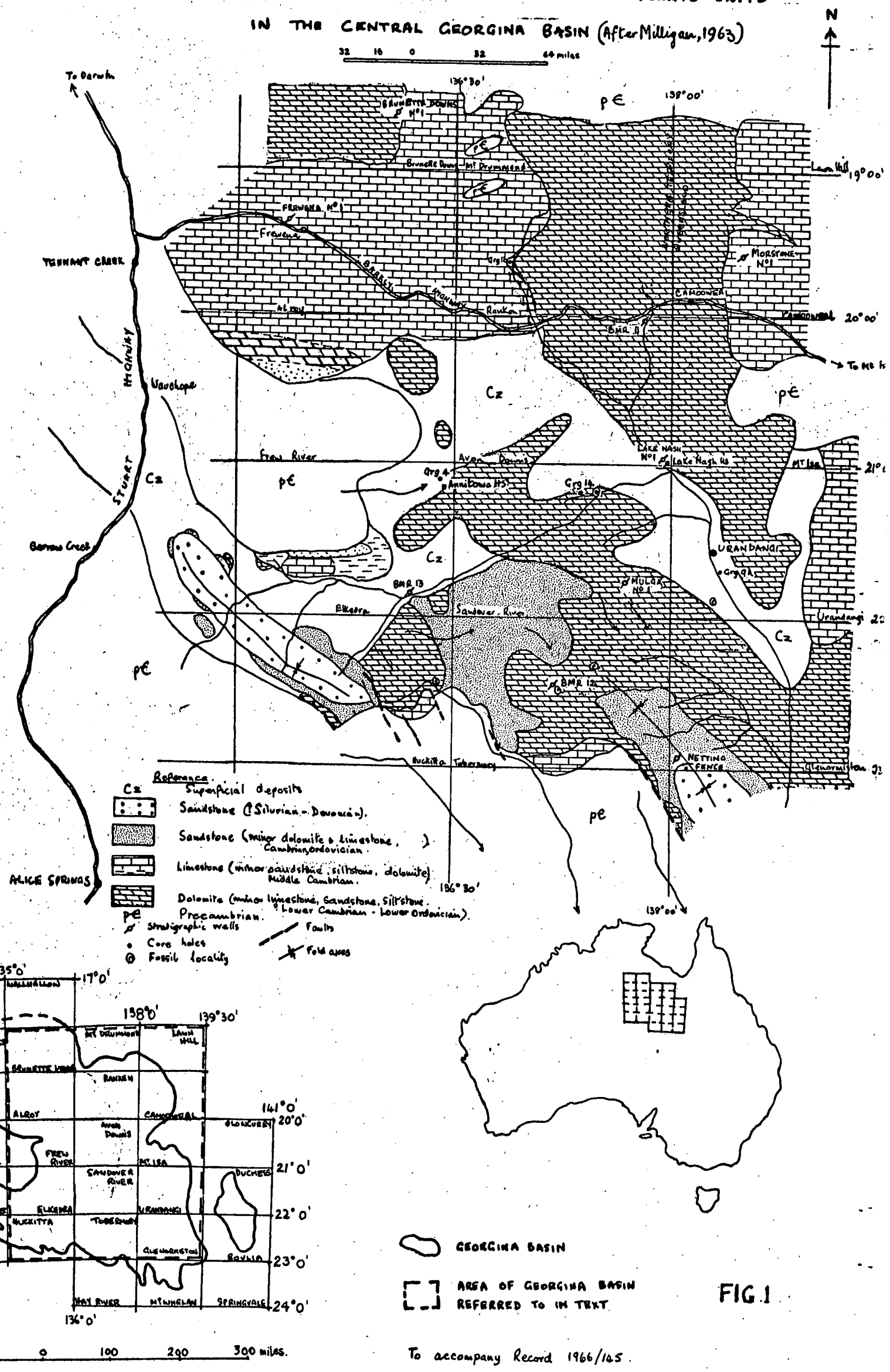
SUMMARY

The record presents a summary of the petrography of four stratigraphic wells drilled in the Georgina Basin, namely, Mulga No.1, Lake Nash, No.1, BMR 11 (Cattle Creek) and BMR 12 (Cockroach).

The wells penetrated essentially a dolomite sequence with interbeds of limestone and thin quartz sandstone in some sections. The dolomite is predominantly microcrystalline, but pelletal-oolitic dolarenites occur, which may be equivalent in three wells.

The stratigraphic implications of the sequence found in Mulga No.1 and the other wells are discussed, and it is suggested that the current stratigraphic nomenclature and formations and beds by which the dolomite unit is named and subdivided, be reviewed or revised according to the recommended standards of the Stratigraphic Committee of the International Geological Congress.

GENERALISED GEOLOGICAL SETTING OF CARBONATE UNITS IN THE CENTRAL GEORGINA BASIN (After Milligan, 1963)



GEORGINA BASIN

AREA OF GEORGINA BASIN REFERRED TO IN TEXT

FIG. 1

To accompany Record 1966/145.

MULGA NO. 1 WELL AND ITS STRATIGRAPHIC IMPLICATIONS, GEORGINA BASIN.

INTRODUCTION

General

This record presents a brief appraisal of the petrography of the dolomite in Mulga No. 1 well and its implication on the regional stratigraphy.

Mulga No. 1 well was drilled by Alliance Petroleum, Australia NL on oil permit No. 63 in the Georgina Basin, N.T. and is situated in the Sandover River Sheet area at 21°42'3" south and 137°38'18" east (Fig. 1).

It was drilled to a total depth of 3003 feet and penetrated dolomite, minor siltstone and sandstone (0-1974 feet), silicified sandstone and rare dolomite (1974 - 2620 feet), and interbedded shales and siliceous limestone (2620 - 3003 feet).

The sequence of dolomite (0 - 1974 feet) exhibits minor facies variations but is subdivided into the currently accepted and mapped units of the Ninmaroo Formation (Upper Cambrian - Lower Ordovician), Arrinthrunga Formation (Upper Cambrian) and Marqua Beds (Middle Cambrian) (Laing, 1965, p.2). The gamma and electric logs show slight changes and the present formation boundaries appear to coincide with these.

No fossils were found in Mulga No. 1 well and although it is stated that the Cambro-Ordovician beds in parts of the basin have been divided into 'formations' which are actually stages being recognised on their fossil content rather than their lithology (Laing, 1965, p.9), the sequence was still subdivided into formations and beds.

The present study was undertaken to search for fossils and for lithologies similar to those in Lake Nash No.1, BMR 11 and BMR 12, and to determine if it is valid to subdivide the dolomite sequence into beds and formations in this part of the Georgina Basin. The core and cuttings were etched and dissolved in hydrochloric acid (10%), and examined, dry and wet, under a binocular microscope at magnifications of x40 and x 80.

PETROGRAPHY

Mulga No. 1

The sequence penetrated in Mulga No. 1 is shown on the accompanying log (Enclosure 1). Microcrystalline dolomite is predominant throughout, but contains thin interbeds and laminae of clay-siltstone, quartz sandstone and rare limestone and chert in the upper part. In the middle part, microcrystalline dolomite is slightly argillaceous and rarely sandy or silty, while in the lower part it is interbedded with pelletal, oolitic and composite-grain dolarenites.

The petrography of the lithologies is as follows.

Microcrystalline dolomite: varies in colour from grey and brown to white; some is calcareous. The texture is generally equigranular, the crystals ranging from 20-62 microns. Inequigranular and porphyritic textures, laminate and cross bedding were not observed. In dissolved fractions, clay minerals, quartz silt and sand and chert grains form most of the insoluble residue. Glauconite rarely occurs.

Microcrystalline limestone: varies from white to brown in colour and has an equigranular texture with crystals ranging from 20-62 microns.

Quartz sandstone: is grey in colour and composed of fine grained, subrounded quartz.

Clay-siltstone: varies from grey to grey-green and black and comprises clay minerals, quartz silt and carbonaceous(?) material. Some is calcareous. Generally it occurs in laminae and may be insoluble residue after pressure solution.

Chert: varies from white to grey and is aphanitic, being composed of cryptocrystalline silica. In one interval it shows pelletal texture indicating replacement of a pelletal carbonate.

Pelletal, oolitic and composite-grain dolomite: varies from brown to white in colour; the grains range from 62 microns to 1mm in size and are average to well sorted. The pellets are of microcrystalline dolomite and the ooliths have thin concentric rims; fibrous texture is unidentifiable. The composite grains are composed of pellets and ooliths and may represent intraclasts (Folk 1959, p.1). The texture varies from grain-on-grain to apparently mud-supported. No interval is composed of only oolitic or pelletal dolomite.

These dolarenites occur predominantly from 1740 - 1900 feet (160 feet thick).

CORRELATION

Lake Nash No. 1

Lake Nash No. 1 is situated 56 miles north-north-east of Mulga No. 1 (Fig. 1) and penetrated dolomite (0 - 586 feet), limestone (586 - 790 feet), dolomite (790 - 990 feet), and sandstone (990 - 1315 feet) with 70 feet of dolomite (1090 - 1160 feet) (Wolf, 1963). Brown (1965, p.5-6) subdivided the dolomite (0 - 990 feet) on depositional characteristics, but did not further subdivide the limestone; descriptions of the facies are summarised below.

Microcrystalline dolomite: varies from buff to grey in colour and shows equigranular microcrystalline to very fine crystalline textures. Silt is ubiquitous; clay is usually present, and some fine to medium grained quartz sand occurs. Chert, collophane and glauconite occur sporadically throughout.

Pelletal, oolitic and intraclastic dolarenites: vary from buff to grey in colour and contain abundant ooliths, pellets and intraclasts, commonly well sorted and densely packed, with coarse clear crystalline matrix. Other intervals show pellets etc, in a cloudy microcrystalline matrix (op cit, p.5), and as ghosts of original sediment particles. Clay minerals are absent or present in traces.

These rocks occur between 270 - 380 feet (110 feet thick).

Bioclastic dolomites and limestones: vary in colour from light to medium grey and dark grey. They contain skeletal fragments of brachiopods and sponge spicules and some trilobites, abundant enough to form mud-free arenite sediments; others contain skeletal fragments in microcrystalline calcite and dolomite matrix, many of them occurring as ghosts in the dolomites. Some of the fragments are phosphatised and collophane-rich.

Microcrystalline limestone: varies from dark grey to light grey and has nearly uniform cryptocrystalline to microcrystalline textures. Some is silty and clayey, and partly dolomitised, while some is nearly silt free and porcellanous.

Mudstone-siltstone: varies from buff and grey to orange and brown in colour, and contains silt and fine grained sand. Some siltstone is dolomitic.

BMR 11 (Cattle Creek)

BMR 11 (Cattle Creek) is situated 65 miles north of Lake Nash No. 1 (Fig. 1) and penetrated dolomite (0 - 1195 feet), limestone (1195 - 1275 feet), dolomite (1275 - 1412 feet) and sandstone (1412 - 1501½ feet) (Johnson, Nichols and Bell, 1964, p.12). The various lithologies are summarised below.

Microcrystalline dolomite: varies from white, grey and yellow, to brown, greenish-grey and grey-brown in colour. It is generally cryptocrystalline to microcrystalline, but medium crystalline patches also occur. It is slightly calcareous in parts, argillaceous in others (635 - 740 feet), with some traces of glauconite, pyrite and manganese. It is commonly vuggy and stylolitic. Rare chert and quartz sand also occur.

Pelletal and oolitic dolarenites: vary from white, to yellow in colour. Pellets and ooliths are oval and circular and vary from 300 - 600 microns in size; pellets are composed of microcrystalline dolomite; only the concentric layering of the ooliths is visible and is often superficial. Both occur in a groundmass of microcrystalline and medium crystalline dolomite.

They occur predominantly between 290 - 450 feet (160 feet thick).

Microcrystalline limestone: varies from medium grey to brown and from cryptocrystalline to microcrystalline. It has vague granular texture in parts and is laminar in others, with grey-black, vague pellets(?). Some fossil fragments occur, and also nodules of blue-grey and brown cryptocrystalline chert.

BMR 12 (Cockroach)

BMR 12 (Cockroach) is situated 48 miles south-south-west of Mulga No. 1 (Fig. 1) and penetrated interbedded dolomite and limestone with rare thin beds of clay-siltstone and quartz sandstone (0 - 2721 feet), and interbedded calcareous quartz sandstone and limestone (2721 - 4000 feet T.D.) (Nichols and Bell, 1965). The lithologies are summarised below.

Microcrystalline dolomite: varies from light and medium grey and white, to blue-grey, green, grey-brown, and red-brown. It is partly

argillaceous, rarely quartzose, partly calcareous, and contains some dark grey, thin clay-siltstone laminae. Rare ferruginous intervals occur.

Pelletal and oolitic dolarenite and calcarenite: vary from white to light grey in colour with oval and circular sand-size pellets of microcrystalline dolomite and calcite; ooliths have concentric layering and are well sorted, occurring in a groundmass of microcrystalline dolomite and calcite. They form rare interbeds in the sequence.

Microcrystalline limestone: where interbedded with dolomite it is light grey to green-grey and medium brown in colour, is partly argillaceous, and rarely micaceous.

Where it is interbedded with calcareous quartz sandstone it varies from light grey to medium and dark grey, is argillaceous, micaceous(?) and contains quartz silt in some parts.

Quartz sandstone: where interbedded with dolomite and limestone it varies from light brown to white, is fine grained with subangular to subrounded quartz in siliceous cement.

Calcareous quartz sandstone is light to medium grey, fine grained and contains subrounded, well sorted quartz in a strongly calcareous matrix; scattered black opaque minerals also occur. It probably grades into quartzose limestone in some intervals.

Clay-siltstone: varies from medium and dark grey, to black, blue, purple, brown and red-brown. It comprises clay minerals and possibly mica and quartz silt, with some carbonaceous (?) material, and is dolomitic in parts. It occurs commonly in laminae.

Discussion

In view of the lithological information from these wells the author considers that the validity of the formations and beds and the current stratigraphic nomenclature in this part of the Georgina Basin should be revised or reviewed.

Milligan (1963, p.16, p.20) remarked on the extent of lithologically similar dolomite in this part of the basin, and also on the similarity between dolomite of the Ninmaroo Formation and the Camooweal Dolomite, and the differences of the various lithologies assigned to the Ninmaroo Formation.

The information presented here confirms Milligan's statements and also indicates that the present formation boundaries between the Meeta Beds and the Ninmaroo Formation, and between the Arrinthrunga Formation and the Ninmaroo Formation are invalid when drawn between dolomite and dolomite, or within a sequence of interbedded dolomite and limestone. This has also been recognised in part by other geologists, for example, by Michoud, Eyssautier and Gates (1964, p.13) and Laing (1965, p.9) though the latter adhered to the current nomenclature in subdividing the uniform sequence in Mulga No. 1.

It is considered that the dolomite sequences in Mulga No. 1, Lake Nash No. 1, BMR 11 (Cattle Creek) and BMR 12 (Cockroach) are part of one Formation (Fig. 2) initially published as the Camooweal Dolomite (Opik, 1957, Fig. 1 in Cambrian geology of Queensland; Fig. 2 in Cambrian geology of the Northern Territory). Intervals of limestone and quartz sandstone may be mapped as members, but generally the dolomite is unrelieved by other lithologies (Milligan, 1963, p.16).

As few fossils have been found it is impossible to establish time units precisely. The dip is to the south-west and fossils from the lower part of the dolomite are of Middle Cambrian age in BMR 11 and Lake Nash No. 1, and Lower Ordovician age at the top of the sequence in BMR 12. Mulga No. 1 penetrates dolomites between exposures containing Upper Cambrian (?) fossils and Lower Ordovician fossils (Tomlinson and Opik, BMR, pers. comm.), but none were found in the well.

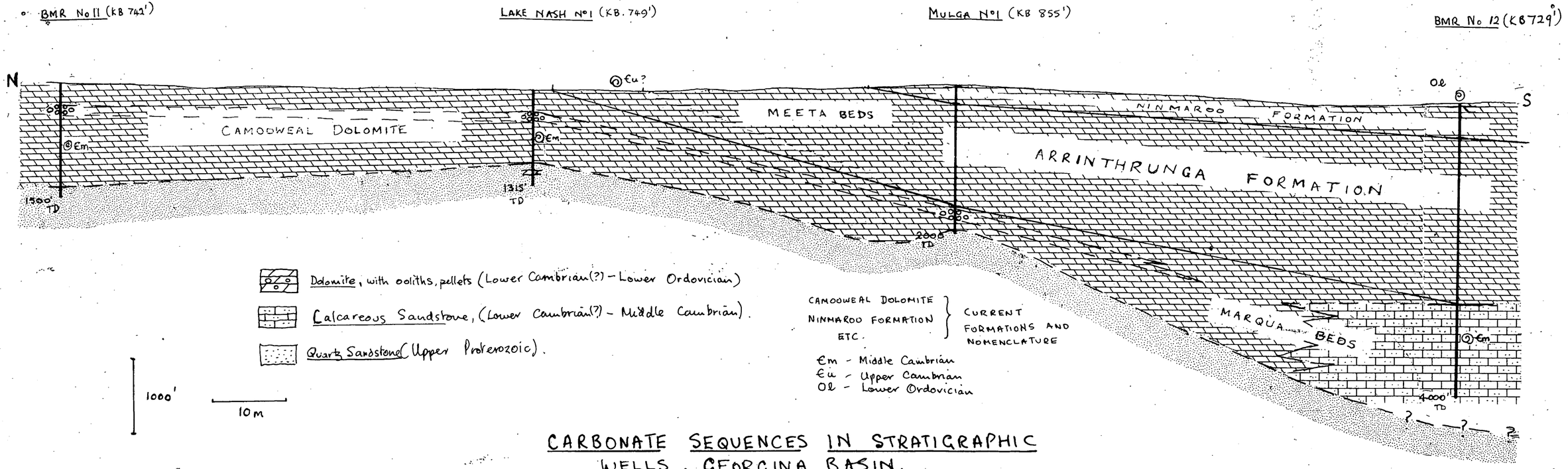
It is tentatively proposed that the pelletal-oolitic intervals near the top of the dolomite in BMR 11 (Cattle Creek) and Lake Nash No. 1 and near the bottom of Mulga No. 1 are equivalent. It requires a dip of only $\frac{1}{4}^{\circ}$ to the south, which is compatible with the regional picture, for this interval to occur at 1740 feet in Mulga No. 1.

The interval cannot be traced in BMR 12 (Cockroach) and here the dolomite-limestone sequence overlies interbedded calcareous sandstone and limestone forming the Marqua Beds, which may represent a lateral variation (Fig. 2).

CONCLUSIONS

Consequently, it is submitted that there is essentially one dolomite rock unit, with limestone interbeds in parts, which is preserved in thickness from approximately 1000 feet - 2700 feet, and varies in known age from Middle Cambrian to Lower Ordovician. In the north it overlies what is considered economic basement, while in the south it overlies a possible lateral variant, a calcareous quartz sandstone interbedded with limestone.

FIG. 2.



CARBONATE SEQUENCES IN STRATIGRAPHIC WELLS, GEORGINA BASIN.

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MULGA No 1

SANDOVER RIVER 1:250,000 SHEET AREA, SF 53/8

LAT. 21° 42' 3"S

LONG. 137° 38' 18"E

ELEV. 855 feet

Limestone

Dolomite, microcrystalline

Dolomite, argillaceous

Dolomite, silty

Dolomite sandy

Dolomite, pelletal oolitic

Clay - siltstone

Quartz sandstone

Gl Glauconite

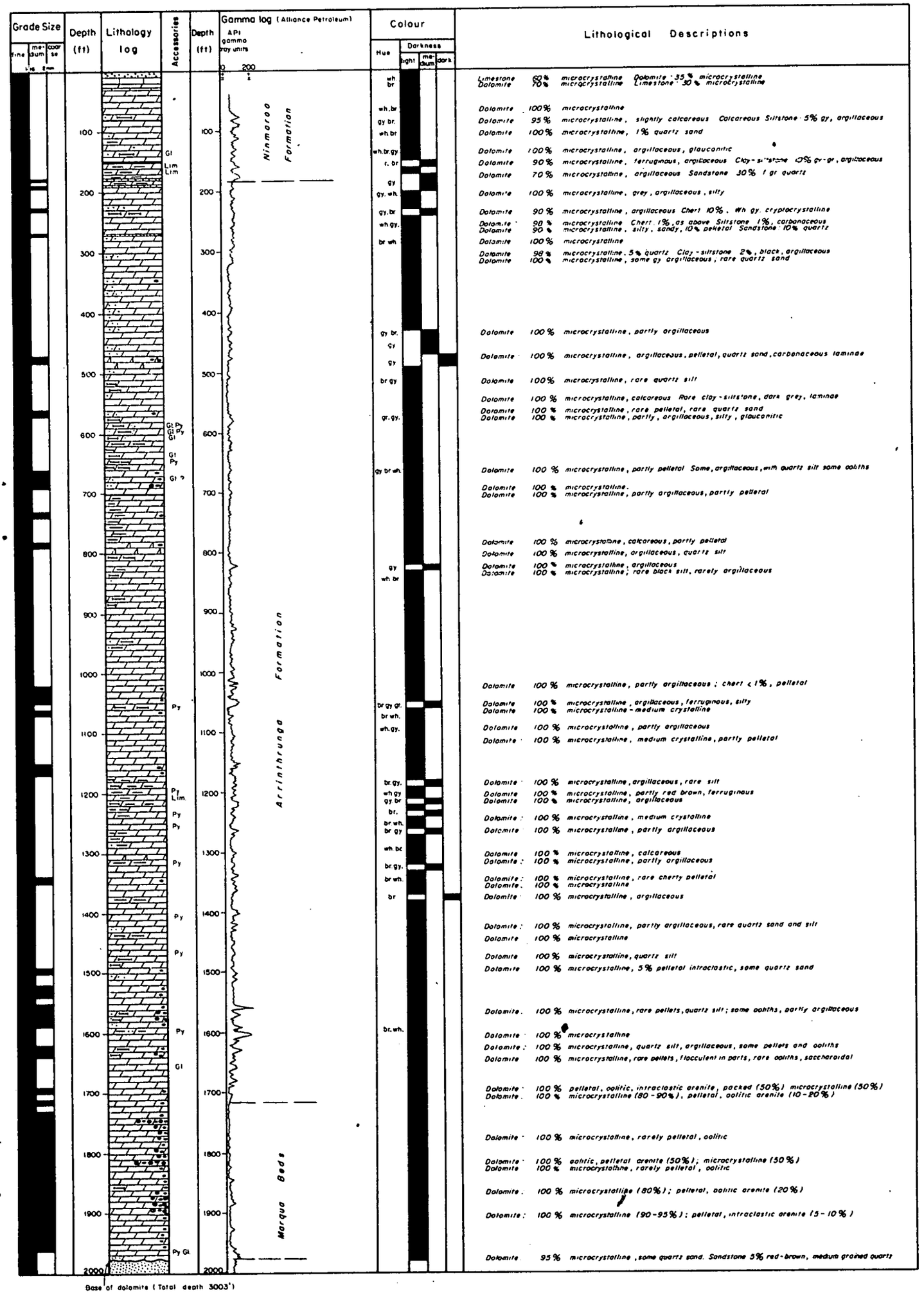
Py Pyrite

br Brown

wh White

gy Grey

r. br. Red - brown



Base of dolomite (Total depth 3003')

Bureau of Mineral Resources, Geology and Geophysics. September 1966. To accompany Record 1966/155

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