DEPARTMENT OF ~~NATIONAL RESOURCES~~ NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1979/36

BMR STRATIGRAPHIC DRILLING IN THE GEORGINA BASIN, 1977 AND 1978

Compiled by J.H. Shergold and M.R. Walter

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ABSTRACT

This Record documents 18 shallow stratigraphic holes drilled during the 1977 and 1978 stratigraphic drilling program in the Georgina Basin. Where possible, holes were continuously cored, and these cores have been slabbed to provide petrological reference material, and material for destructive analysis. The coreholes penetrated the Upper Proterozoic to Middle Cambrian sequences in the Hay River 1:250 000 Sheet area; Upper Proterozoic to Upper Cambrian sequences in the Mount Whelan 1:250 000 Sheet area; Middle Cambrian in the Yelvertoft area of the Barkly Tableland (Mount Isa Sheet area); Middle and Upper Cambrian sequence in the Burke River Structural Belt (Duchess and Boulia Sheet areas); and Lower Ordovician and Lower Devonian sequences in the Toko Syncline (Tobermory and Mount Whelan Sheet areas). Lithological logs, palaeontological determinations, and geochemical analyses are recorded where available.

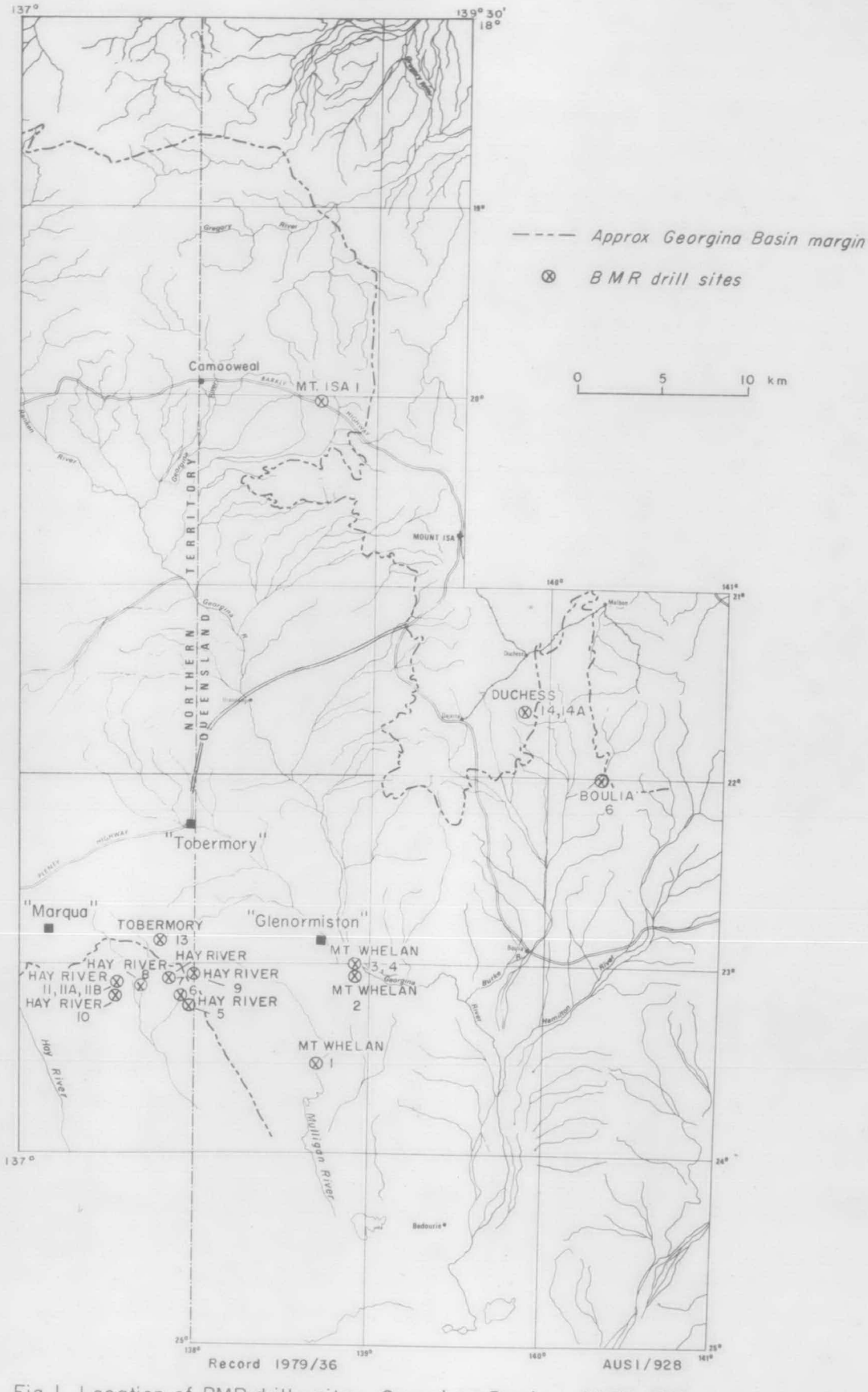

Fig 1 Location of BMR drill-sites, Georgina Basin, 1977-78

INTRODUCTION

During the 1977 BMR stratigraphic drilling program in the Georgina Basin, Mayhew 1000 and trailer-mounted Gemcodril 210B rigs, under the supervision of E.H. Cherry, were utilised to drill Upper Proterozoic and Lower Palaeozoic stratigraphic units in support of a BMR field team investigating the Adam 1:100 000 Special Geological Sheet, and a combined BMR/GSQ team investigating the Mount Whelan 1:100 000 Sheet. Holes were also drilled on the Tobermory and Boulia 1:250 000 Sheet areas to resolve problems outstanding from the earlier (1974) drilling program in the Basin (Kennard & Draper, 1977).

In 1978, a Mayhew 1000 rig, operating under E.D. Lodwick, drilled a further four holes in the Adam 1:100 000 Sheet area, and two more on the Duchess 1:250 000 Sheet, but was unable to complete the scheduled program because of heavy rains early in the season. Later in 1978, however, a second Mayhew rig under the supervision of L. Keast, returning to Canberra from Pine Creek, was able to complete the program by drilling Mount Isa No. 1.

A total of 18 holes were drilled during the 1977 and 1978 drilling programs, and where necessary these were continuously cored. Cores are stored at the BMR Core and Cuttings Laboratory, Fyshwick, ACT. The procedure for core description and analysis has been given previously (Kennard & Draper, 1977).

PRELIMINARY RESULT

Detailed lithological logs are reproduced as Figures 5-12. Symbols and abbreviations used on these logs are listed in Tables 8 and 9. Palaeontological information, where available, is given in Appendix 1; petrographic analysis of Hay River No. 10 is given in Appendix 2; and geochemical analyses (Tables 1-7) are included in the text as appropriate. Analyses have been undertaken by BMR, the Australian Mineral Development Laboratories (AMDEL), and CSIRO Mineral Research Laboratory (MRL).

BOULIA No. 6 (extension)

Well index number: 2275
Date: October-November 1977
Position: 140°18'E, 22°00'S (Figs 1,2)
Objective: To extend Boulia No. 6, previously drilled (1974) to 98.9m, to explore the relationships between Chatsworth Limestone and Pomegranate Limestone; to establish stratigraphic superposition; and to examine the interval of Chatsworth Limestone which outcrops intermittently on the black soil plains northwest of "Chatsworth" HS.
Rig: Mayhew 1000
Drilling: Apart from an 18 cm gap between 173.05 - 175.30 m, continuous coring from 102.50 - 178.30 m when circulation was lost.
Geologists: J.H. Shergold, J.M. Kennard
Discussion: The lithological log of the extension of Boulia No. 6 (Fig. 5) should be read in conjunction with that previously published for the upper part of the corehole (Kennard & Draper, 1977, fig. 3a). The topmost beds of the extended hole are a continuation of those recorded previously from the base of the earlier hole.

Three broad groups of lithologies are recorded (Fig. 5): an uppermost shelly grainstone and mudstone intercalation, associated with breccias; a middle "shaly limestone" or calcareous siltstone unit; and a basal mudstone and micritic limestone intercalation. The first group of lithologies outcrops along the northern edge of the Chatsworth Limestone exposure north of "Chatsworth", and adjacent to the intersection of Horse Creek and the Mort River. The last lithological association is also known on the plains north and northwest of "Chatsworth" and between Coolibah Bore and Mount Murray on the western margin of the Burke River Structural Belt. Thus this corehole fulfills one of the stated objectives in permitting scattered surface outcrops to be placed in stratigraphic sequence. The hole failed, as far as is known, to intersect Pomegranate Limestone, bottoming and losing circulation in a mudstone interval at 178.30 m.

Biostratigraphically (Appendix 1), the trilobite faunas occurring at the base of the earlier drilled hole continue into the upper grainstone/mudstone unit of the extension, and this is consistent with surface out-

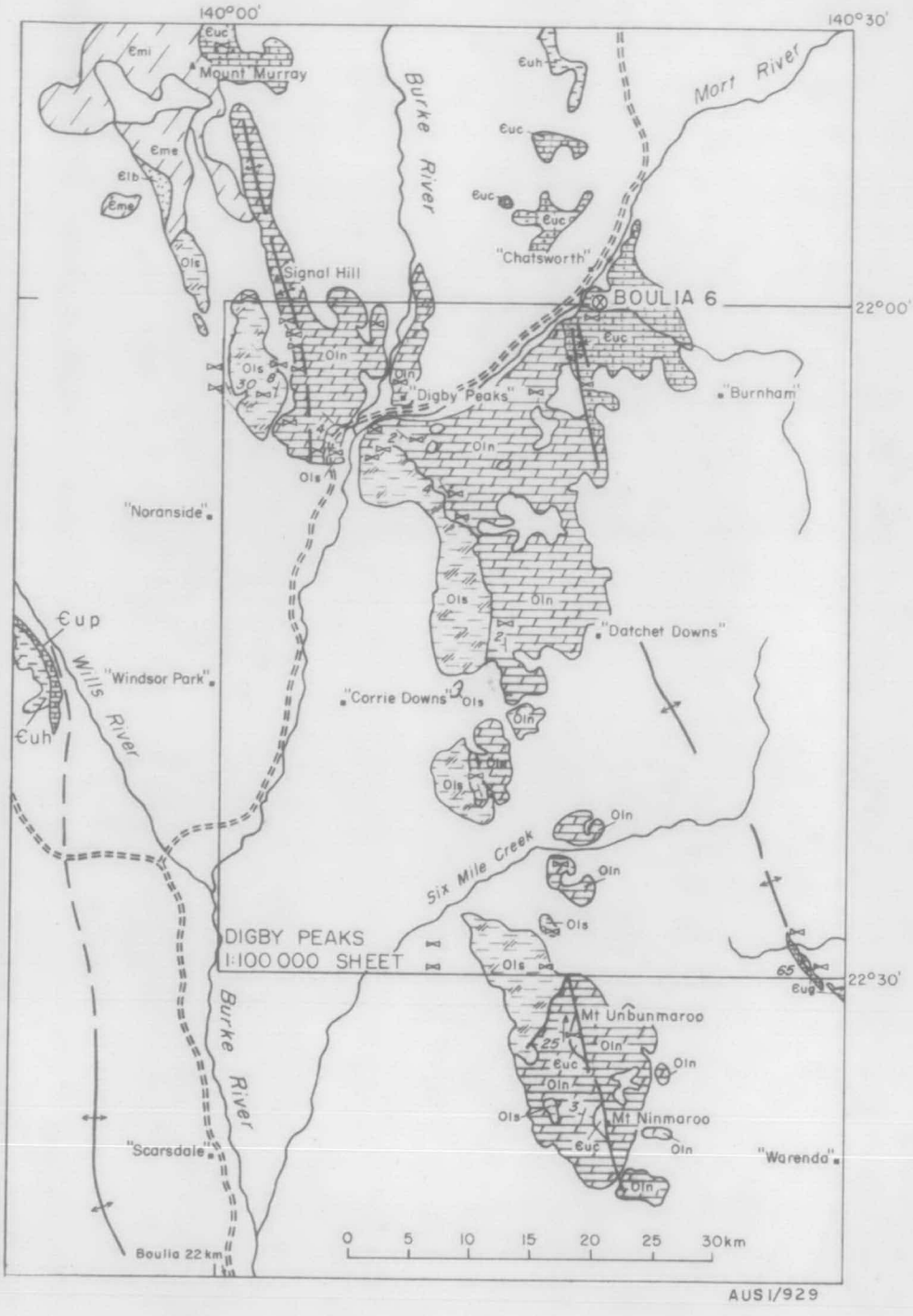

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Fig 2 Location of BMR Boulia No. 6.

crop information. However, no new biostratigraphic data are available for the lower unit of the Chatsworth Limestone. No Idamean fauna has been recognised, and relationships with the faunas of the Pomegranate Limestone remain unclear.

DUCHESS No. 14

Well index number:	N/A
Date:	August 1978
Position:	139°50'E, 21°40'S (Figs 1,3)
Objective:	To sample unweathered phosphorite from the Beetle Creek Formation.
Rig:	Mayhew 1000
Drilling:	No sampling in initial 73.4 m; continuous coring with poor recovery between 73.4 - 91.00 m; terminated by loss of circulation.
Geologist:	M.W. Sandstrom (ANU)

Discussion: This hole was sited by, and on the advice of Mines Exploration Pty Ltd adjacent to former percussion drill site PDH 30. This site was one of only a few at which unweathered non-calcareous phosphorite was intersected during the Company's drilling program in 1967.

Coring commenced at 73.4 m. The interval 73.4 - 82.0 m consists of black, finely laminated pyritic shale which can be referred to the Inca Formation. Bedding is fractured and grades with depth into collapse breccia. Dark grey to black indurated pelletal phosphorite interbedded with thin (2 cms) layers of finely laminated phosphatic siltstone and black chert occur between 82.0 - 91.0 m in the underlying Monastery Creek Phosphorite Member of the Beetle Creek Formation. Minor amounts of coarse, dark brown friable sandy phosphorite occur. Recovered core consists of angular fragments and chips of collapse breccia. Percentage phosphate and total organic carbon analyses are shown on Table 1.

WELL NAME	SAMPLE	DEPTH (m)	STRATIGRAPHIC UNIT	P_2O_5 %	TOTAL CARBON (%)	ORGANIC CARBON (%)	$CaCO_3$ %
DUCHESS 14	74715671	79.1	INCA FM.	0.5	2.94	2.82	1.03
"	74715672	82.5	BEETLE CK.FM.	34.6	1.63	1.16	3.88
"	74715673	82.9	" "	33.1	0.74	0.22	4.28
"	74715674	89.0	" "	14.1	0.67	0.40	2.31
DUCHESS 14A	74715675	85.1	" "	29.0	1.93	1.51	3.48
"	74715676	85.6	" "	-	0.61	0.19	3.54

Table 1: Phosphate and organic carbon values in BMR Duchess Nos. 14, 14A (supplied by M.W. Sandstrom, ANU)

DUCHESS No. 14A

Well index number: N/A
Date: August 1978
Position: 139°50'E, 21°40'S (Figs 1,3)
Objective: Same as Duchess No. 14
Rig: Mayhew 1000
Drilling: No core was recovered between 0-80.9 m; continuous coring with poor recovery between 80.9-88.9 m; hole terminated because of time constraints on drilling crew.
Geologist: M.W. Sandstrom (ANU)
Discussion: BMR Duchess No. 14A was situated 30 m west of Duchess No. 14 in an attempt to obtain better recovery and assess the extent of the brecciation in that hole. Dark grey to black indurated pelletal phosphorite interbedded with thin (2-3 cms) layers of black chert and dark grey finely laminated phosphatic siltstone was cored between 80.9 - 88.9 m. Recovered core consists of angular fragments of sedimentary breccia: bedding and fractures are stained with iron oxide.

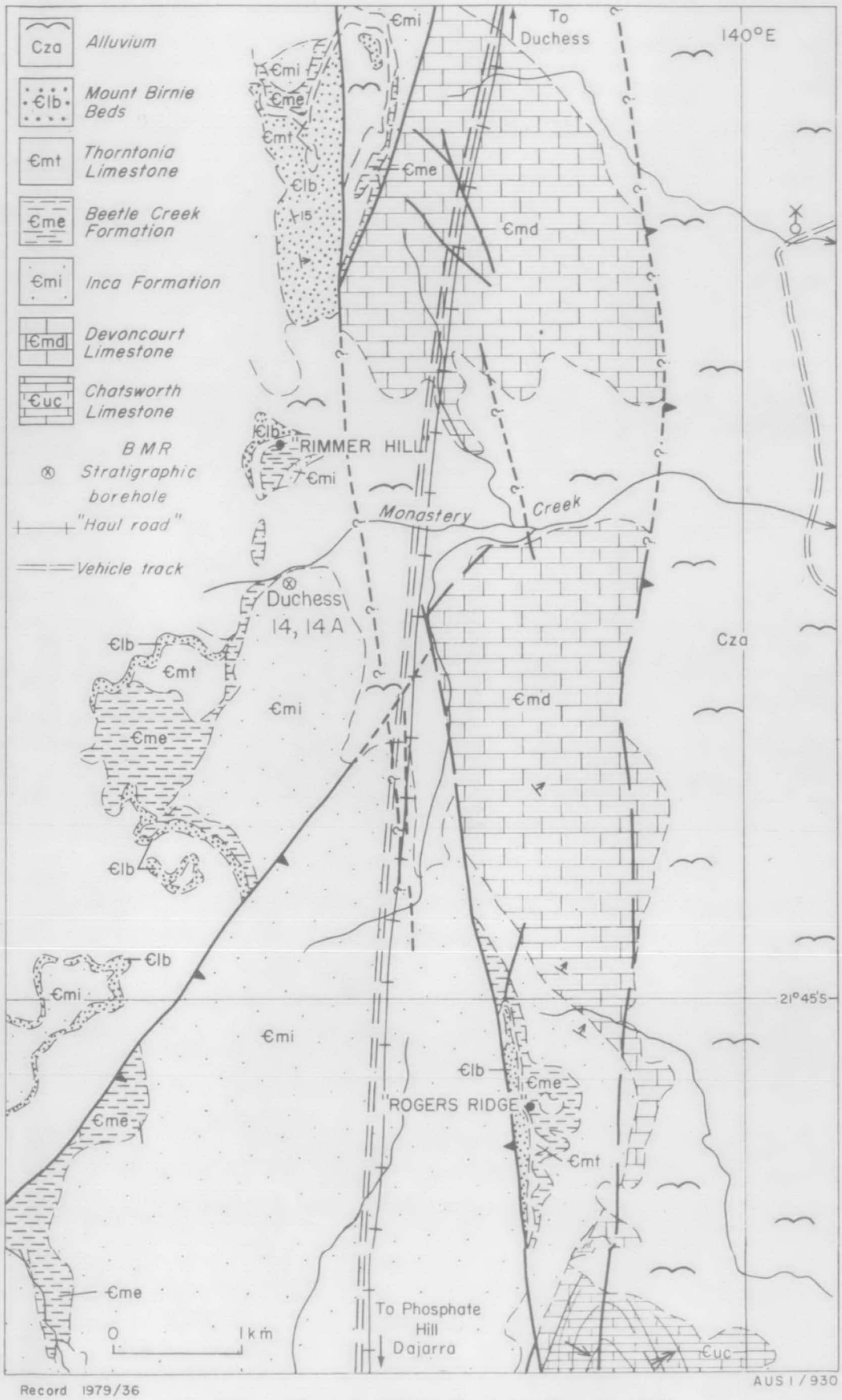

Fig 3 Location of BMR Duchess Nos 14, 14 A

HAY RIVER No. 5

Well index number: 2978
Date: August - September 1977
Position: 137°54'12"E, 23°11'9S (Fig. 1)
Objective: This hole was spudded into the Yardida Tillite on the crest of the Field River Anticline, in an attempt to determine the nature of the sequence beneath the tillite.
Rig: Mayhew 1000
Drilling: Cores from 68.00 - 108.80 m, 123.85 - 143.35 m, 151.80 - 160.40 m, 184.90 - 189.25 m, 225.00 - 228.00 m, cuttings from the remainder of the hole.
Geologist: M. R. Walter
Discussion: The objective was not achieved, because the Yardida Tillite proved to be much thicker at this locality than where its thickness had been originally estimated, south of the Desert Syncline. When the hole was completed at 229 m it was still in tillite.

The tillite is intensively fractured on the crest of the anticline, resulting in strong flows of potable water at several levels. The log of this hole is reproduced as Figure 6.

HAY RIVER No. 6

Well index number: 2979
Date: August 1977
Position: 137°52'48"E, 23°10'42"S (Fig. 1)
Objective: To check on the presence of a dolomite unit within or below the Yardida Tillite suspected because of the presence of a dolomite rubble train on the surface
Rig: Gemcodril 210B
Drilling: Continuous coring to 60 m
Geologist: M.R. Walter
Discussion: The only dolomite found during drilling was in the form of boulders in diamictite. With further surface observations, this indicates that no dolomite beds are present. However, boulders of stromatolitic dolomite are very abundant in beds about 1 m thick. The core obtained contains a wide range of structures and could be of considerable interest for sedimentological studies of glacial rocks.

HAY RIVER No. 7

Well index nu 2980
Date: August 1977
Position: 137°51'18"E, 23°6'15"S (Fig. 1)
Objective: To drill the contact between the Black Stump Arkose and the Yardida Tillite, to determine its nature.
Rig: Gemcodril 210B
Drilling: Continuous coring to 32.5 m
Geologist: M.R. Walter and C.J. Simpson
Discussion: South of the Desert Syncline the top of the Yardida Tillite is marked by 100 m of black shale with dolomite beds and lenses - a persistent marker unit that is extremely widespread in Australia. In the Abudda Lakes 1:100 000 sheet area this unit seems to be missing at the one locality where the contact with the Black Stump Arkose is exposed, and it was therefore suspected that the contact is an unconformity. The black shale unit is also missing in Hay River No. 7. Despite some structural disturbance of the rocks in this hole, the absence of the black shale is considered to confirm the interpretation that the contact is in fact an unconformity. The location of the contact in the core, however, is uncertain (Fig. 7).

HAY RIVER No. 8

Well index number: 2981
Date: August 1977
Position: 137°41'0" E, 23°8'12"S (Fig. 1)
Objective: To core a major recessive unit in the Wonnadinna Dolomite; to determine its lithology; and particularly to test the possible presence of evaporites.
Rig: Gemcodril 210B
Drilling: Continuous coring to 48 m
Geologists: M.R. Walter and P.J. Kennewell
Discussion: The location of several major faults within the Wonnadinna Dolomite and the surface occurrence of gypsum along these faults had led to the hypothesis that the formation may contain evaporites which acted as lubricants during faulting. In addition, large intervals of the formation do not crop out at all. The site is adjacent to a vegetation anomaly on outcropping dolomite.

No evaporites were found. The core consists of interbedded sandstone, arkose, siltstone, shale and minor dolomite, and supports field observations indicating the intergradation of the Black Stump Arkose and the Wonnadinna Dolomite (see log, Fig. 8).

HAY RIVER No. 9

Well index number: 2982
Date: August 1977
Position: 139°59'0"0"E, 23°04'00"S (Fig. 1)
Objective: To establish the lithostratigraphy of the Cravens Peak Beds; the nature of their contact with the Ethabuka Beds; and to determine whether the "thelodont-bearing limestone" is present.
Rig: Gemcodril 210B
Drilling: Continuous coring to 63 m
Geologist: J.J. Draper
Discussion: This core has not been logged in detail. The Lower Devonian "thelodont-bearing limestone" was proved to be absent below the Cravens Peak Beds. Instead, a red mudstone sequence was discovered between the Cravens Peak Beds and the Ethabuka Beds, but its age (Devonian or Ordovician) is uncertain. Similar red mudstones occur below the Cravens Peak Beds at one other locality in the Toomba Range, approximately 3 km south of Cravens Peak Bore on the Glenormiston 1:250 000 Sheet area.

HAY RIVER No. 10

Well index number: 3021
Date: July 1978
Position: 137°33'6"E, 23°10'6"S (Fig. 1)
Objective: To determine the unweathered lithology of a deeply weathered ferruginous shale at the top of the Yardida Tillite; to test its correlation with the Aralka Formation of the Amadeus Basin; to provide unweathered samples for petrographic and geochemical analysis; and to determine the cause of zinc enrichment in the surface outcrops.

Rig: Mayhew 1000

Drilling: Continuous coring to 127 m

Geologists: M.R. Walter, E.C. Druce

Discussion: This unit was known only from several very small outcrops south of the Desert Syncline, and one outcrop at Boat Hill, on the southern part of the Tobermory Sheet area. The outcrops south of the Desert Syncline are deeply weathered jarositic ferruginous shale which is enriched in zinc (Table 2) and which contains small-scale boxwork fabrics indicating the former presence of pyrite and possibly sphalerite (with some indication of remobilisation of these sulphides)(Report by J. Wilmshurst, CSIRO).

Sample number	Cu(1)	Pb(1)	Zn(20)	Ag(0.1)	Cd(3)
74717961A	30	20	1000	0.1	x
B	30	30	400	x	x
C	30	15	700	x	x
D	60	30	2000	x	x

Table 2. Analyses of surface samples from the dolomitic shale capping the Yardida Tillite, from Hay River No. 10 drill site. x = not detected at the limits quoted. Results in ppm. Detection limits in brackets. AMDEL Report AN 2800/78.

7471	5822	5823	5824	5825	5827	5828	5829	5830	5832	5833
SiO_2										
TiO_2										
Al_2O_3										
Fe	5.1	4.0	5.3	5.3	5.1	4.4	3.1	5.2	2.5	2.9
MnO										
Mg	2.3	3.2	5.9	2.2	1.9	1.9	2.5	1.6	2.2	1.7
Na_2O										
K	2.7	2.4	1.5	3.1	3.2	3.8	3.7	4.2	2.8	2.4
P_2O_5										
Ag	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
As	14	12	8	16	19	8	21	32	5	4
Ba										
Bi	2	2	2	2	2	2	2	2	2	2
Cd	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Co	21	18	13	24	27	26	18	30	11	15
Cr										
Cu	38	34	23	48	52	8	35	32	19	52
Ga										
Ge										
La										
Mn	321	586	1349	502	431	217	580	204	481	496
Nb										
Ni										
Pb	23	22	25	54	71	22	75	100	11	126
Rb	162	148	87	183	199	198	212	253	151	133
S										
Sb										
Se	2	2	2	2	2	2	2	2	2	2
Sn										
Sr										
Th	16	16	11	20	24	23	21	26	17	15
U	4	4	3	5	5	4	4	5	3	3
V										
W	3	3	3	3	3	3	3	3	3	3
Y	37	35	30	35	40	33	29	33	32	36
Zn	93	71	54	137	39	172	55	73	59	622

Table 3: Analyses of core samples from Hay River No. 10. Sample numbers cross-reference to the lithological log reproduced as Fig. 9. Major elements in percentiles, minor elements in ppm.

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The drilling confirmed that the unweathered lithology is a laminated, dark grey, pyritic and carbonaceous shale which near its base contains thin beds and lenses of dolomite (Fig. 9). This lithology is very distinctive and the correlation with the Aralka Formation of the Amadeus Basin and the Tapley Hill Formation of the Adelaide Geosyncline was confirmed.

The results of chemical analyses are shown in Table 3. Results of petrographic examination (J. Knutson) are given in Appendix 2. Total Organic Carbon analyses given by K. Jackson are as follows: sample 74715819, 0.31% in whole rock; 74715824, 0.90%; 74715829, 0.47%.

HAY RIVER No. 11

Well index number:	3020
Date:	July 1978
Position:	137°32'12"E, 23°07'24"S (Fig. 1)
Objective:	To determine the stratigraphic sequence above the Grant Bluff Formation in the Desert Syncline; to provide unweathered samples for petrographic and chemical analyses to test the possibility of economic mineralisation in an Early-Middle Cambrian dolomite.
Rig:	Mayhew 1000
Drilling:	Continuous coring to 73 m, terminated by caving and loss of circulation between 73-75 m
Geologists:	M.R. Walter, J.H. Shergold, and E.C. Druce

Discussion: The sequence above the Grant Bluff Formation in the Desert Syncline outcrops poorly. Silicified archaeocyathan coquinite coquinite occurs as rubble, indicating the probable presence at depth of a carbonate unit. The rubble contains large quartz crystals, with fluid inclusions which indicate a high temperature hydrothermal event. Chemical analysis of surface samples of the rubble indicated some enrichment in silver (Table 4).

Sample number	Cu(2)	Pb(2)	Zn(20)	Ag(0.1)	Cd(3)
74717311A	10	20	30	6	x
B	30	5	30	5	x
C	20	30	30	5	x

Table 4. Analyses of surface samples of silicified coquinite from the Desert Syncline. x = not detected at the limits quoted. Results in ppm. Detection limits in brackets. AMDEL Report AN 2800/78.

Drilling revealed the stratigraphic sequence shown in Fig. 10. Chemical analyses of core samples are given in Tables 5-7. Palaeontological analyses are given in Appendix 1.

Three stratigraphic units can be recognised. The lowest 7 m consists of dark grey fetid silty wackestone and calcareous siltstone containing redlichiid and eodiscid trilobites, inarticulate brachiopods, and bradoriid crustacea, which indicate an Ordian (Early Middle Cambrian) age. A middle unit, 0.52 m thick, consists of intraclastic grainstone, containing Pagetia, Peronopsis and Xystridura, indicative of a Templetonian (Middle Cambrian) age. It shows erosional contact with the lowest unit. The uppermost stratigraphic unit, represented by the topmost 62 m of Hay River No. 11, comprises a predominantly laminated siltstone sequence with thin interbeds of fine-grained silty wackestone resembling the Marqua Beds of the Marqua Monocline, 72 km to the north. The limestone layers contain agnostid trilobites and sponge spicules, the former indicating the presence of the Ptychagnostus punctuosus Zone and providing evidence of a stratigraphic break between the middle and uppermost units of the corehole.

7471	5795	5798	5800	5801	5809	5810	5811	5815	5816	5817	5835	5836	5837	5838	5839
SiO_2															
TiO_2															
Al_2O_3															
Fe	2.1	2.4	1.8	0.79	1.4	2.1	6.5	7.3	10.1	6.5	3.0	1.9	4.9	1.0	1.4
MnO															
Mg	1.8	0.21	7.4	12.5	00.18	0.29	0.39	0.24	0.22	0.37	8.1	10.0	9.7	11.8	11.8
CaO															
Na_2O															
L	1.8	1.8	1.5	0.24	2.3	2.8	3.0	1.5	1.6	0.49	1.5	0.18	0.23	0.04	0.18
P_2O_5															
Ag	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	3	7	3	3	4
As	14	28	17	7	4	2	5	18	27	54	12	8	12	7	5
Ba															
Bi	2	2	2	2	2	2	5	2	2	3	2	2	2	2	2
Cd	NIL	NIL	NIL	4	NIL	NIL	NIL	NIL	NIL	NIL	NIL	14	NIL	6	2
Co	10	19	6	6	720	28	162	67	26	4	11	25	7	5	
Cr															
Cu	29	40	13	7	7	5	3	11	58	10	12	4	11	5	7
Ga															
Ge															
La															
Mn	310	20	670	690	10	20	90	90	260	2850	680	1500	960	780	950
Nb															
Ni															
Pb	11	21	64	12	7	3	6	14	45	34	38	9	13	8	6
Rb	73	106	53	10	102	137	176	60	64	22	53	9	9	3	7

Table 5 (cont'd)

7471	5795	5798	5800	5801	5809	5810	5811	5815	5816	5817	5835	5836	5837	5838	5839
S															
Sb															
Sc	2	2	2	2	2	2	2	4	2	2	NIL	NIL	NIL	NIL	NIL
Sn															
Sr															
Th	11	21	10	2	11	15	17	15	9	11	8	2	2	2	2
U	9	18	7	2	5	2	8	2	2	1	6	1	6	2	1
V															
W	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Y	34	73	51	3	17	21	1438	82	24	23	43	2	10	3	5
Zn	34	24	734	169	17	9	14	8	9	10	587	515	339	210	89

Table 5: Analyses of core samples from Hay River Nos. 11, 11A & 11B. See Fig. 10 for reference

Corehole	Sample No.	$\%P_2O_5$
Hay River No. 11	74715793	0.10
	74715794	0.15
	74715795	0.10
	74715796	2.40
	74715797	0.85
Hay River No. 11A	74715799	0.15
	74715801	0.20
Hay River No. 11B	74715804	0.20
	74715805	0.05

Table 6. Analysis of P_2O_5 in Hay River coreholes Nos. 11, 11A and 11B. AMDEL report AN 2019/79. For location of samples see Fig. 10.

Corehole	Sample	Total Organic Carbon (%)	Extractable Organic Matter (ppm)	Saturated Hydrocarbon (ppm)	Aromatic Hydrocarbon (ppm)	Polar + Asphaltine (ppm)
Hay River 11	74715793	2.99	167	50	61	55
	74715794	2.02	111	12	18	75
	74715796	0.99	89	10	30	46
Hay River 11A	74715799	1.13	1236	227	193	808
	74715800	1.77	1851	169	296	1397
Hay River 11B	74715816	0.11	207	19	31	150

Table 7. Carbon and hydrocarbon analyses from Hay River coreholes Nos. 11, 11A and 11B. Sample numbers cross-reference with Figure 10 (analyses by BMR Petroleum Technology Laboratory).

HAY RIVER No. 11A

Well index number: 3023
Date: July 1978
Position: 137°32'12"E, 23°07'24"S (Fig. 1)
Objective: As for Hay River No. 11.
Rig: Mayhew 1000
Drilling: Continuous coring to 57 m
Geologists: M.R. Walter, J.H. Shergold, E.C. Druce
Discussion: Circulation was lost at the bottom of Hay River No. 11 due to the presence of cavities up to 2 m high. The rig was then shifted 90 m south to the site of 11A. See the notes for Hay River No. 11.

Hay River No. 11A commenced coring in a black laminated micaceous pyritic siltstone/shale unit 41.50 m thick, thus suggesting faulting between the sites of Hay River Nos 11 and 11A. No fossils have been obtained from the uppermost 41.50 m of Hay River No. 11A, but on stratigraphic considerations it is thought to directly underlie the lowest unit observed in Hay River No. 11. It is itself underlain by approximately 6 m of thin-bedded shelly dolomite, skeletal intraclastic grainstone, wackestone, chert and breccia. The basal layers of this unit are intraclastic, and the upper layers ferruginised, implying that both top and bottom contacts are erosion surfaces. This unit contains probable early Ordian (early Middle Cambrian) phosphatised molluscs, hyolithids and inarticulate brachiopods. The basal unit of Hay River 11A is a vuggy stylolitic dolomite (Fig. 10).

HAY RIVER No. 11B

Well index number: 3024
Date: July 1978
Position: 137°32'12"E, 23°07'24"S (Fig. 1)
Objective: As for Hay River No. 11
Rig: Mayhew 1000
Drilling: Continuous coring between 52.60 and 120 m from surface
Geologists: M.R. Walter, J.H. Shergold, E.C. Druce
Discussion: Drilling problems encountered at 57 m in Hay River No. 11B necessitated shifting the rig about 1 m laterally and drilling again. See the notes for Hay River 11.

Hay River No. 11B commenced coring just above the top of the vuggy stylolitic dolomite at the base of Hay River 11A and penetrated 7.7 m of this formation. Archaeocyatha found in this interval indicate an Atdabanian to Early Lenian age on the Siberian stratigraphic scale (late Early to earliest Middle Cambrian). The basal 1.5 m of this dolomite unit is sandy and contains the U-shaped burrow Diplocaterion sp. It overlies 16 m of mottled green and brown laminated siltstone and shale which contains acritarchs suggesting an Early Cambrian age. In turn this unit overlies sandstones attributed to the Grant Bluff Formation (Fig. 10).

MOUNT ISA No. 1

Well index number: 3097
Date: November 1978
Position: 138°40'E, 20°02'S (Fig. 1)
Objective: Provide information on oil shale of Middle Cambrian age previously reported in the Yelvertoft area.
Rig: Mayhew 1000
Drilling: Continuous coring to 250.5 m, the target depth
Geologist: D.L. Gibson
Discussion: No log has yet been prepared for this hole. Samples have been taken for geochemical analysis to satisfy the objective of the hole. Potential oil shale occurs at eight horizons between intersections at 82-117 m.

MOUNT WHELAN No. 1

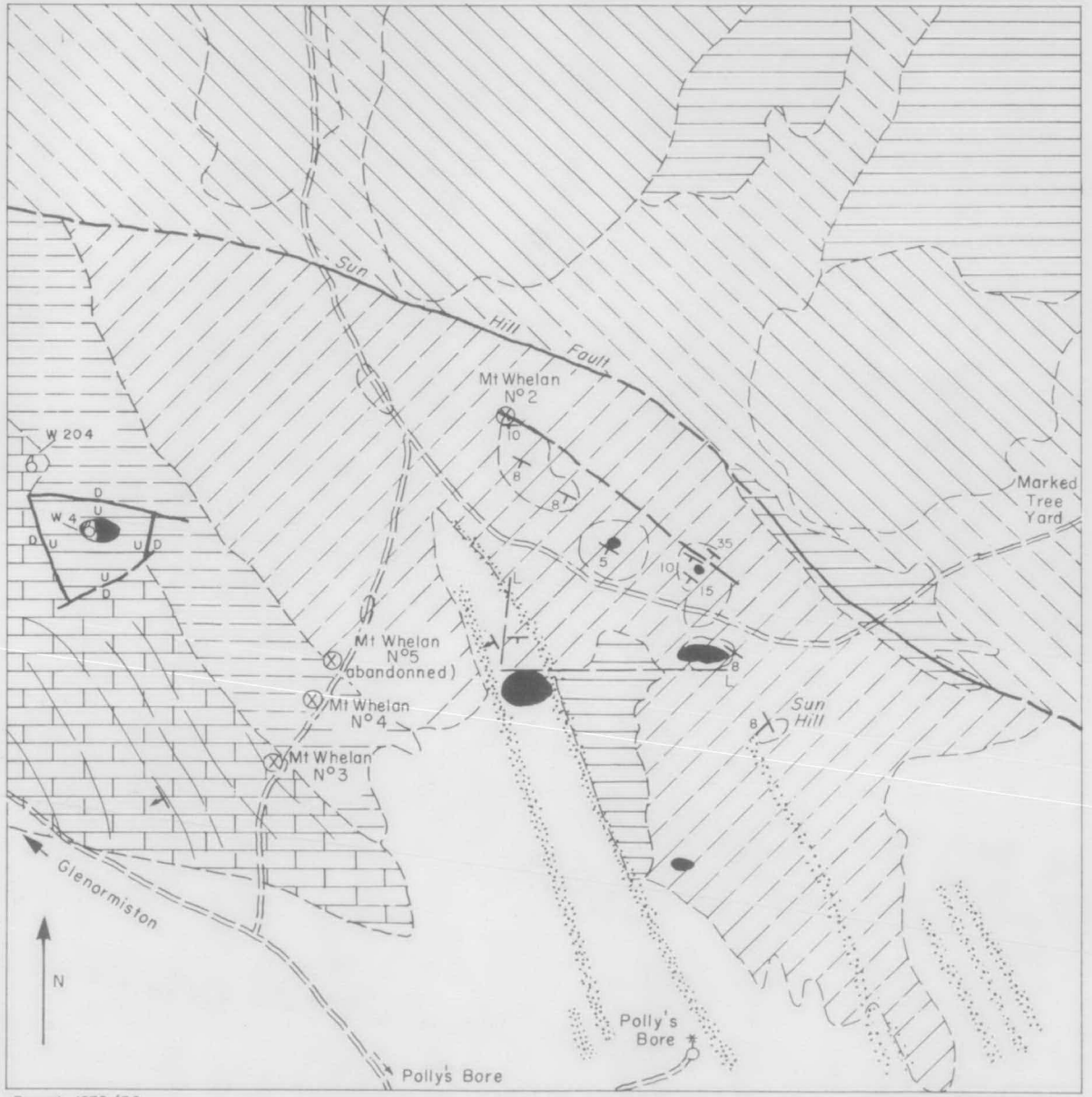
Well index number: 2968
Date: July 1977
Position: 138°43'E, 23°32'S (Fig. 1)
Objective: To establish the lithostratigraphy and stratal relationships of the Mithaka Formation.
Rig: Mayhew 1000
Drilling: Continuous coring between 6.60 - 94.00 m.
Geologist: J.J. Draper

Discussion: No core was obtained in the initial 6.60 m of section. Between 6.60 - 20.60 m a sequence comprising predominantly micaceous silty claystones with interbedded flaser and wavey bedded sandstone is referred to the "Unnamed Sandstone Unit" (see Draper in Shergold & others, 1976, p. 44). From 20.60 to 94 m a sequence of dominantly fine-grained impure bioturbated sandstone with clay pellets, ripple drift lamination, parting lineation, and cross-stratification, contains interbeds with variable or low sand content represented by pyritic, often bioturbated, mudstone and siltstone (Mithaka Formation). Slickensiding, probably representing minor faulting, occurs at 41 m and between 52 - 53 m. Although the Mithaka Formation is fossiliferous throughout, BMR Mount Whelan No. 1 has yet to be analysed biostratigraphically. Trilobites, pelecypods, inarticulate and articulate brachiopods and possible ostracods are shown on the accompanying log (Fig. 11).

MOUNT WHELAN No. 2

Well index number: 2974
Date: September 1977
Position: 138°54'12"E, 23°01'S (Figs 1 and 4)
Objective: To examine the lithostratigraphic sequence of the Sun Hill Arkose in its type area, and attempt to establish its stratigraphic relationships with underlying strata; to assess the relative age of the Sun Hill Arkose.
Rig: Gemcodril 210B
Drilling: Continuous coring to 63 m.
Geologists: J.J. Draper, M.R. Walter, and J.H. Shergold
Discussion: Mount Whelan No. 2 was drilled on the northernmost edge of the Sun Hill Arkose outcrop, approximately 3-5 km northwest of Sun Hill (Fig. 4). Because of a general regional dip to the southwest, it was considered that the lowest exposed Sun Hill Arkose should occur near the drill site and that here it might be possible to establish its relationship with underlying strata, thus proving its relative age.

Lithological similarity of the Sun Hill Arkose to late Proterozoic arkoses occurring on the Hay River Sheet area to the southwest has been noted by Casey (1959). Öpik (1960), however, reported ichnofossils from the Sun Hill Arkose as it occurs in the general vicinity of Dingo Hill, and near



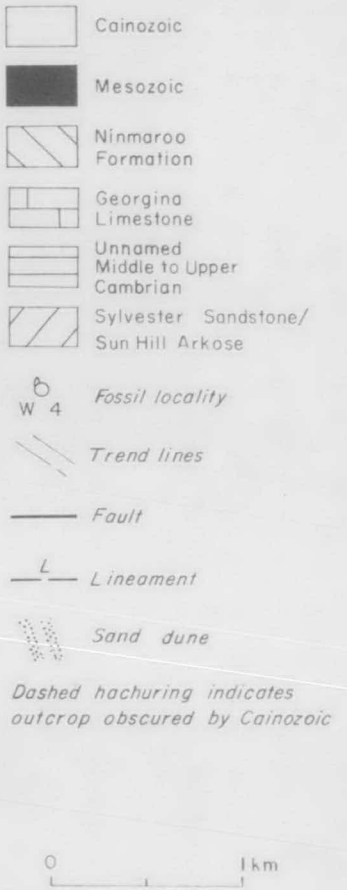


Fig 4 Location of BMR Mount Whelan Nos 2-4

Mount Coley Tank, approximately 18 km southeast and 4 km northeast of Mount Whelan respectively. Accordingly, an Early Cambrian age was ascribed (e.g. Öpik, 1960). The authors dispute the occurrence of structures of organic origin in the Sun Hill Arkose, and prefer to regard them as sedimentary structures, which commonly occur in the finer units of the formation. More recently, a post-Cambrian age has been proposed for the Sun Hill Arkose (Henderson, 1977: pp. 425, 430), in which case the arkoses should be underlain by Middle and Upper Cambrian and/or Lower Ordovician carbonate sequences.

BMR Mount Whelan No. 2 cored 63 m of interbedded coarse to very coarse-grained arkose and finely laminated red, brown and green siltstone (Fig. 1). The arkosic intervals coarsen in the lower 10 m of core, often contain exotic pebbles, and may be classified as granule conglomerate. The siltstone intervals frequently are interlaminated silts, fine whispy sandstones, and fine feldspathic sandstones. No trace of carbonate was observed in this core.

Mount Whelan No. 2 gives no indication of the stratigraphic position or age of the Sun Hill Arkose, but it does give a better understanding of the lithostratigraphy of the formation and of its thickness, which is obviously greater than the 45 m originally estimated (Casey 1959; Smith 1972), and probably closer to the 300 m estimated by Öpik (1960, p. 102).

MOUNT WHELAN No. 3

Well index number:	2975
Date:	September 1977
Position:	138°54'12"E, 23°00'30"S (Figs. 1,4)
Objective:	To explore the relationship of the Georgina Limestone to underlying strata.
Rig:	Gemcodril 210B
Drilling:	Continuous coring to 21 m
Geologist:	P.M. Green

Discussion: BMR Mount Whelan No. 3 was positioned along the station track which leads from Pollys Bore to "Glenormiston" via the Sun Hill Fault (Fig. 4), on the northeasternmost, and thus basal, exposure of Georgina Limestone.

Mount Whelan No. 3 cored 63 m of medium to dark grey finely laminated fine-grained limestone. Work continues on the logging and sampling of this core. Stratigraphic relationships were not proved.

MOUNT WHELAN No. 4

Well index number: 2976
Date: September 1977
Position: 138°54'00"E, 23°00'25"S (Figs 1,4)
Objective: To explore the relationship of the Georgina Limestone to underlying strata.
Rig: Gemcodril 210B
Drilling: Continuous coring to 21 m
Geologist: P.M. Green
Discussion: BMR Mount Whelan No. 4 was sited 400 m to the northeast of Mount Whelan No. 3 along the same track. It was expected that this hole would core the feather edge of the Georgina Limestone which is concealed below sand cover. The initial 11.50 m recovered unconsolidated and semi-consolidated sand and some clay. The section below 11.50 m consists of pallid white, grey and green clay and fine grained sandstone containing micaceous laminae and little felspar. It is thought that this may represent either: (1) an outlier of Mesozoic sediment similar to that occurring north of the Sun Hill Fault (Fig. 4); or (2) the weathered upper part of a Cambrian clastic formation underlying the Georgina Limestone. The latter interpretation is shown on Fig. 4.

Possibly this is the clastic unit which outcrops on the low rise numbered W4 on Fig. 4. This locality is misplaced on the Mount Whelan 1:250 000 Geological Series Sheet, and Henderson (1977, p. 425) has erroneously interpreted it as locality W204 which actually lies a short distance to the northwest.

No fauna has been recovered from Mount Whelan No. 4 corehole.

A third hole, proposed as Mount Whelan (Gemco) No. 5, was sited a further 400 m to the northeast of Mount Whelan No. 4 in the hope of drilling through the base of the Cambrian sequence into Sun Hill Arkose. This hole, spudded on sand, was abandoned due to cavities and a constant inflow of unconsolidated sand at the bottom of the hole. No core was recovered or submitted to the BMR Core and Cuttings Laboratory.

TOBERMORY No. 13

Well index number: 2998

Date: August 1977

Position: 137°48'E, 22°52'S (Fig. 1)

Objective: To establish the lithostratigraphy of the Coolibah Limestone and establish its relationships with over and underlying formations

Rig: Gemcodril 210B

Drilling: Continuous coring to 42.25 m when circulation was lost.

Geologists: J.J. Draper, J.H. Shergold

Discussion: No analysis of this core has yet been made, and no log is available. Preliminary inspection of the core reveals the Coolibah Limestone to comprise predominantly green, grey and yellow nodular and muddy limestone. Circulation was lost on penetration of massive white porcellanous chert at approximately 42 m.

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TABLE 9

ABBREVIATIONS USED ON LITHOLOGICAL LOGS

Abbreviations used on the lithological logs and not shown here are taken from the list of standard abbreviations used by BMR

( ) parentheses denote poor, weakly developed, or rare

___ underlining denotes good, well developed, or abundant

CARBONATE ROCKS

Bndst	boundstone
Grnst	grainstone
Mdst	mudstone
Pckst	packstone
Wckst	wackestone

GRAIN TYPES

clast	intraclast
ooid	ooid
pel	peloid
skltl	skeletal

SEDIMENTARY STRUCTURES

bd, bdd	bed (ed)
biotrbtd	bioturbated
bnd, bndd	band (ed)
crk	crack
fnstrt	fenestrate
grdd, grdg	graded (ing)
intbd, intbdd	interbed (ed)
intlamd	interlaminated
lam, lamd	laminae (ed)
stromat	stromatolite
Xbdd	cross-bedded
Xlamd	cross-laminated
Xstrat	cross-stratified

DIAGENETIC FEATURES

bdng	boudinage
clcrt	calcrete
cpctd, cpctn	compacted (tion)
crnltd	crenulated
fiss	fissile
frac	fracture
intxl	intercrystal
por	porosity
py	pyrite
replmnt	replacement
soln	solution
stn, stnd	stain (ed)
styl	stylolite
sut	sutured
vn	vein
xl	crystal

POROSITY SIZE MODIFIERS

lmg large megapore	(32 - 256 mm)
smg small megapore	(4 - 32 mm)
lms large megapore	(0.5 - 4 mm)
sms small mesopore	(0.06 - 0.5 mm)
mcmicropore	(0.06 mm)

APPENDIX 1

PALAEONTOLOGICAL DETERMINATIONS

Compiled by J.H. Shergold from
contributions by Shergold, P.J. Jones (Hay River 11),
P.D. Kruse (Hay River 11A) and
M.D. Muir (Hay River 11B)

BMR Boulia No. 6 (extension)
BMR Hay River No. 11
BMR Hay River No. 11A
BMR Hay River No. 11B

Note Some taxa recorded from BMR Boulia No. 6 are new, and are *nomina nuda* until the publication of BMR Bulletin 186 which describes the trilobites of the Chatsworth Limestone (Shergold, in prep). Similarly, a new agnostid genus listed from Hay River No. 11 is described by "pik in BMR Bulletin 172 (in press). The new archaeocyath taxon listed by Kruse from Hay River No. 11A is also a *nomen nudum*

BMR BOULIA No. 6

Position in core (metres from top)	Determinations
102.84	trilobite fragments indet.
103.30	inarticulate brachiopod undet. meraspid librigena indet.
103.55	inarticulate brachiopod undet.

104.08	inarticulate brachiopod undet. *Atopasaphus* cf. *stenocanthus* Shergold, 1975
104.17	inarticulate brachiopod undet.
104.30	inarticulate brachiopods undet. meraspid cranidium indet. *Pseudagnostus parvus* sp. nov. *Taenicephalites plerus* sp. nov.
104.31	inarticulate brachiopod undet.
104.36	inarticulate brachiopod undet.
104.55	inarticulate brachiopod undet.
105.05	inarticulate brachiopod undet. *Haniwoides varia* sp. nov. *Pseudagnostus* sp. aff. *mortensis* sp. nov.
105.79	inarticulate brachiopod undet.
106.05	inarticulate brachiopod undet.
106.55	*Taenicephalites plerus* sp. nov.
106.80	ostracode undet. *Homagnostus* sp. indet. *Pseudagnostus* cf. *mortensis* sp. nov. *Taenicephalites plerus* sp. nov. hypostoma undet.
107.30	trilobite fragments indet.
107.80	inarticulate brachiopod indet.
108.05	inarticulate brachiopod indet.

108.30	inarticulate brachiopod undet. trilobite fragments indet.
108.80	inarticulate brachiopod undet.
109.05	inarticulate brachiopod undet. Pseudagnostus mortensis sp. nov.
109.30	inarticulate brachiopods undet.
110.05	inarticulate brachiopod undet.
110.80	inarticulate brachiopod undet.
111.55	inarticulate brachiopod fragments indet.
112.05	inarticulate brachiopod undet
113.05	trilobite fragment indet.
113.30	inarticulate brachiopod undet.
120.50	inarticulate brachiopod indet.
123.50	inarticulate brachiopod undet.
124.50	inarticulate brachiopods undet.
127.25	inarticulate brachiopod indet.
128.05	inarticulate brachiopod indet.
129.50	inarticulate brachiopod indet.
130.75	pseudagnostid sp. indet.
134.46	ostracode undet. bradoriid crustacean undet.

135.48	inarticulate brachiopod undet.
135.74	inarticulate brachiopod undet. Homagnostus? sp. indet. trilobite fragments indet.
135.98	pseudagnostid trilobite indet.
137.20	inarticulate brachiopod undet.
137.45	inarticulate brachiopod indet.
138.11	inarticulate brachiopod undet.
138.30	inarticulate brachiopod fragment aff. Anabolotreta Rowell & Henderson, 1978
138.36	inarticulate brachiopod undet.
138.81	inarticulate brachiopod aff. Anabolotreta Rowell & Henderson, 1978
139.59	inarticulate brachiopod undet.
139.61	inarticulate brachiopods undet.
140.00	inarticulate brachiopod undet.
140.23	inarticulate brachiopods undet. agnostid trilobite undet.
140.38	inarticulate brachiopod undet.
141.16	inarticulate brachiopod undet.
141.56	inarticulate brachiopod undet.

141.64	inarticulate brachiopods undet. trilobite fragments indet.
141.74	inarticulate brachiopod fragment
142.00	pseudagnostid trilobite aff. Pseudagnostus idalis "pik, 1963, P. aulax sp. nov., or Neoagnostus felix sp. nov.
142.74	inarticulate brachiopod indet. Pseudagnostus parvus sp. nov.
142.99	inarticulate brachiopod undet. trilobite fragments indet.
144.00	inarticulate brachiopod undet. trilobite fragment indet. ostracode? undet.
145.48	inarticulate brachiopod aff. Dactylotreta Rowell & Henderson, 1978
162.11	inarticulate brachiopod undet.
163.38	bradoriid crustacean aff. Eremos Moberg & Segerberg, 1906
172.80	inarticulate brachiopod fragment indet.
174.80	inarticulate brachiopod fragment indet.
177.10	fragments of carbonaceous material
177.50	fragments of carbonaceous material

BMR HAY RIVER No. 11

Position in core (metres from top)	Determinations
21.00 - 21.10	Aotagnostus gen. et sp. nov. Diplagnostus sp. undet. Ptychagnostus punctuosus punctuosus (Angelin, 1854)
25.02 - 25.14	agnostid trilobite fragment indet.
30.88 - 31.03	inarticulate brachiopods undet.
32.58 - 32.75	Aotagnostus gen. et sp. nov. Ptychagnostus sp. ex gr. punctuosus (Angelin, 1854)
33.70 - 33.95	Ptychagnostus sp. undet.
36.18 - 36.36	Diplagnostus sp. undet, Ptychagnostus sp. ex gr. punctuosus (Angelin, 1854)
38.85 - 38.95	Sponge spicules undet. Ptychagnostus sp. ex. gr. punctuosus (Angelin, 1854)
39.50 - 39.60	agnostid trilobite undet. Ptychagnostus sp. undet. bradoriid crustacean undet.
41.75 - 42.00	Aotagnostus gen. et sp. nov. Diplagnostus sp. undet.
43.90 - 44.13	Ptychagnostus ex gr. punctuosus (Angelin, 1854)

50.90 - 51.10	Triplagnostus? sp. undet. bradoriid crustacean undet.
52.63 - 52.90	Ptychagnostus ex gr. punctuosus (Angelin, 1854) Triplagnostus? sp. undet.
53.88 - 54.00	trilobite fragments indet.
54.79 - 54.92	sponge spicules undet. Ptychagnostus ex gr. punctuosus Triplagnostus? sp. undet. (Angelin, 1854)
55.96 - 56.85	sponge spicules undet. Ptychagnostus ex gr. punctuosus (Angelin, 1854)
57.43 - 57.80	Ptychagnostus sp. indet.
58.67 - 58.73	trilobite fragments indet.
61.24 - 61.44	sponge spicules undet. Ptychagnostus sp. undet.
64.65 - 64.93	sponge spicules undet. Ptychagnostus ex gr. punctuosus Ptychagnostus sp. undet. (Angelin, 1854)
65.90 - 66.35	sponge spicules undet. Ptychagnostus sp. aff. lundgreni Tullberg, 1880 Ptychagnostus sp. undet. Ptychagnostus sp. ex. gr. punctuosus (Angelin, 1854)

67.50 - 67.70	inarticulate brachiopods undet. Pagetia sp. undet. Peronopsis sp. undet. Xystridura fragments undet.
67.75 - 67.90	inarticulate brachiopods undet. hyolithid gen. et sp. undet. Xystridura sp. undet.
68.00 - 68.25	inarticulate brachiopods undet. Pagetia sp. undet. Redlichia sp. undet. bradoriid crustaceans undet. (two genera)
68.28 - 68.50	inarticulate brachiopods undet. Pagetia sp. undet. bradoriid crustacean aff. Aristaluta sp. Öpik, 1961.
68.58 - 68.73	inarticulate brachiopods undet. Pagetia sp. undet. redlichiid trilobite fragments indet.
68.73 - 69.00	inarticulate brachiopods undet. bradoriid crustacean, aff. Tuzoia Walcott, 1912, or Reticulocambria Müller, 1964
69.12 - 69.77	bradoriid crustaceans, aff. Beyrichon, rotundata Matthew, and aff. Tuzoia or Reticulocambria
69.78 - 70.25	inarticulate brachiopods undet. trilobite fragment indet. bradoriid crustacean indet.
70.26 - 70.50	inarticulate brachiopods undet.
70.50 - 70.55	inarticulate brachiopods undet.

70.55 - 70.92	inarticulate brachiopods undet. Pagetia cf. inferstrix Jell, 1970 redlichiid trilobite fragments
70.92 - 71.20	inarticulate brachiopods undet. redlichiid trilobite fragments
71.20 - 71.68	inarticulate brachiopods undet. Redlichia sp. undet.
71.70 - 71.71	trilobite fragments indet.
71.71 - 71.95	inarticulate brachiopods undet.
72.00 - 72.23	inarticulate brachiopods undet.
72.25 - 72.29	bradoriid crustacean undet.
72.30 - 73.00	inarticulate brachiopods undet. trilobite fragments indet.

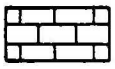
BMR HAY RIVER No. 11A

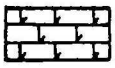
Position in core (metres from top)	Determinations
45.35 - 48.50	brachiopod debris indet. echinodermal plates? indet.
48.50 - 50.00	inarticulate brachiopods undet. hyolithids undet. bradoriid crustacean? undet. phosphatic monoplacophoran undet.
50.00 - 50.50	inarticulate brachiopods undet. hyolithids undet. phosphatic monoplacophorans undet.

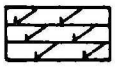
TABLE 8

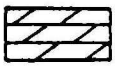
SYMBOLS USED ON LITHOLOGICAL LOGS

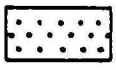
LITHOLOGIES

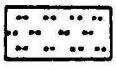

limestone

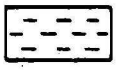

dolomitic limestone


calcareous dolostone


dolostone


sandstone


siltstone


shale, mudstone


chert


calcareous


dolomitic


chert nodules

conglomeratic


sandy


silty

shaly, muddy


brecciated

veins

BEDDING


very thick (> 100 cm)


thick (30 - 100 cm)


medium (10 - 30 cm)


thin (1 - 10 cm)

laminated (< 1 cm)

SEDIMENTARY STRUCTURES


lamination


cross-lamination


cross-bedding


ripple, symmetrical


ripple, asymmetrical


slumped bedding


desiccation cracks


pull apart, syneresis cracks


bioturbation, burrows

GRAIN TYPES


peloid

ooid

intraclast


pisolith, oncolite


trilobite


brachiopod


pelecypod, rostroconch.


pelmatozoan

sponge spicule

ostracod

algae, stromatolite

skeletal algae

fossil undifferentiated

SAMPLE TYPE

P► petrographic

G► geochemical

50.95 - 51.00	inarticulate brachiopods undet. phosphatic monoplacophorans undet.
53.50 - 56.80	undet. fragments of septate, apparently atabulate Archaeocyatha, possibly including Amadeacyathus toddi gen. et sp. nov. ?Dictyocyathus irregularis Taylor, 1910 irregular synapticulate, apparently atabulate archaeocyath possible radiocyath Archaeocyatha undet.

BMR HAY RIVER No. 11B

Position in core (metres from top)	Determinations
63.00 - 63.05	Acritarcha (several morphs): Micrhystridium lanatum Volkova, 1969 Solisphaeridium sp. Deunffia flagellata Jankauskas, 1975 Protosphaeridium densum Timofeev, 1966 Protosphaeridium muirii Bliss, 1979 Acrifarch A Bliss, 1979 Form B (iii) Bliss, 1977

APPENDIX 2

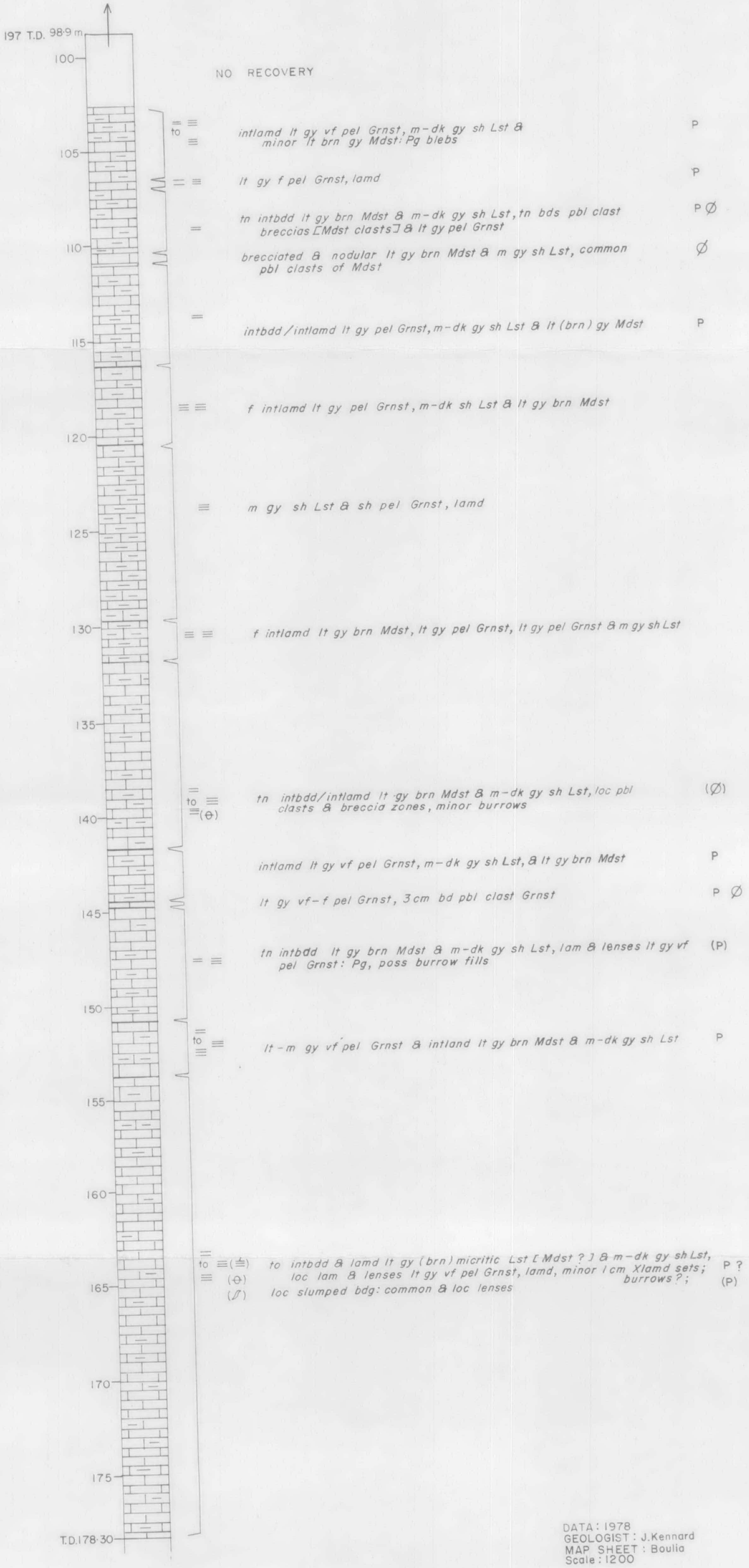
PETROGRAPHIC DETERMINATIONS

by J. Knutson

BMR Hay River No. 10

Samples 74715822 to 832 are finely laminated limestone/dolomite, siltstone and carbonaceous siltstone. Extremely carbonaceous layers commonly define laminations and some samples show graded bedding. Slump and microfaulting structures are common and a number of samples contain intra-formational breccia fragments. Extremely fine framboidal pyrite (generally less than 0.005 mm dia.) is disseminated throughout all samples, although the greatest concentration is in the carbonaceous layers where it commonly defines bedding. In one instance pyrite framboids total about 7%, but more commonly they total 1-4%. These framboids appear to be of syngenetic or early diagenetic origin. Subhedral and euhedral pyrite is generally confined to lenses and veins containing crystalline carbonate and secondary quartz. Pyrite cubes range up to 1 mm across, but more commonly are about 0.05 to 0.75 mm across. In one instance pyrite amounts to about 40% of a 1 cm thick carbonate-secondary quartz-pyrite lamination. Much lower pyrite concentrations (2-10%) are more common. Minor sphalerite is associated with this mineralisation.

Sample 74715833 is a diamictite. Apart from minor very fine-grained pyrite scattered throughout the matrix, sulphide minerals (sphalerite, pyrite, chalcopyrite) are generally confined to carbonate fragments. Sphalerite up to 2 mm across and apparently replacing carbonate is the most common sulphide mineral, and contains fairly abundant small globules of chalcopyrite. Minor euhedral chalcopyrite also occurs as discrete crystals within carbonate fragments. Mn-oxides are commonly confined to these fragments. The carbonate in these fragments is colourless, generally shows evidence of recrystallization, and fine-grained pyrite is concentrated around quartz inclusions in these areas. However, the most coarsely crystalline carbonate has well defined triple-point junctions, is dusty brown, and sulphide minerals are absent.



DATA: 1978
GEOLOGIST: J.Kennard
MAP SHEET: Boulia
Scale: 1200

AUS 1/932

Record 1979/36

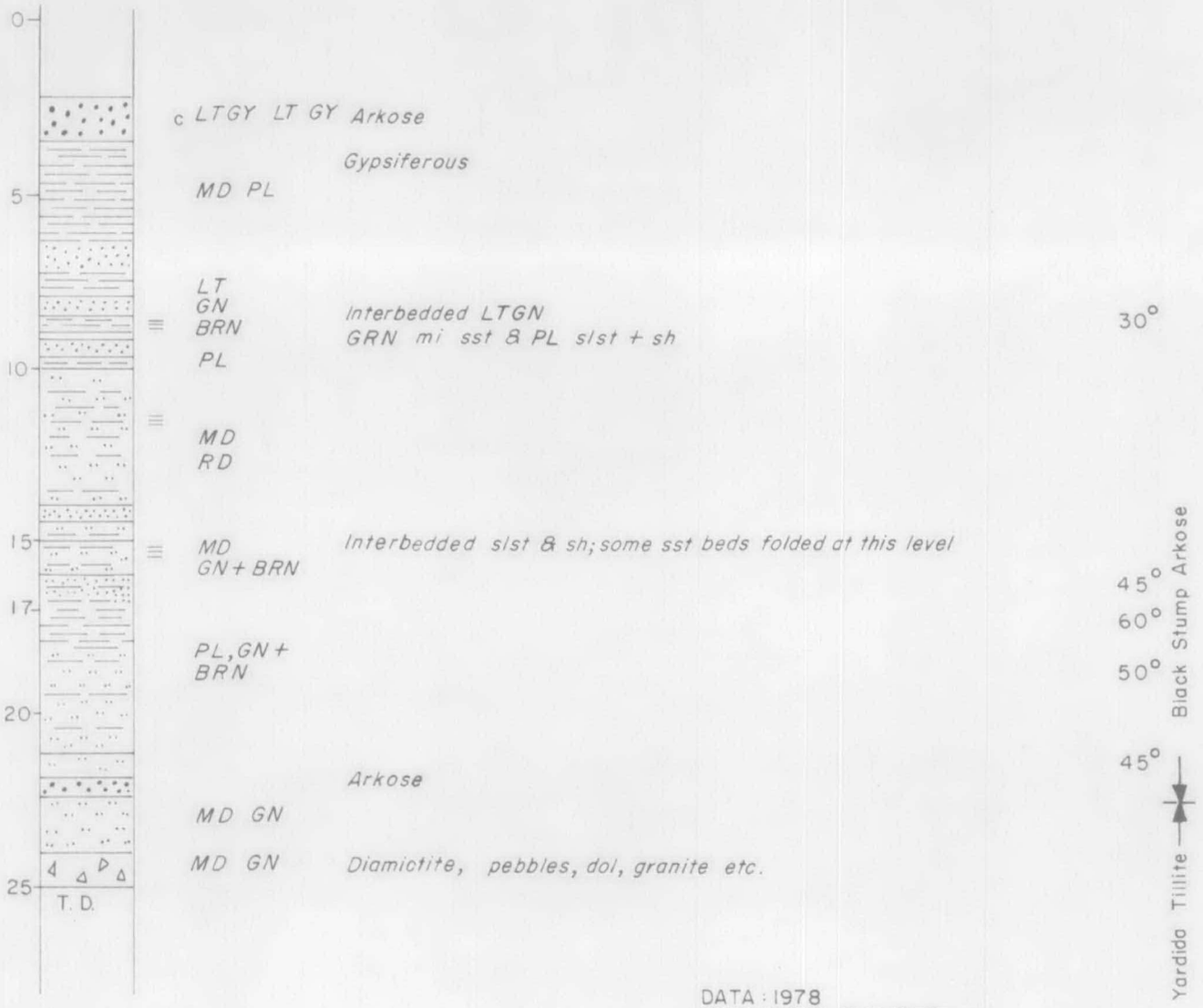
Fig. 5 Lithological log BMR Boulia No. 6 (extension)

DATA : 1978
GEOLOGIST : M.R.Walter
MAP SHEET : Hay River
Scale : 1:200

Record 1979/36

AUS 1/933

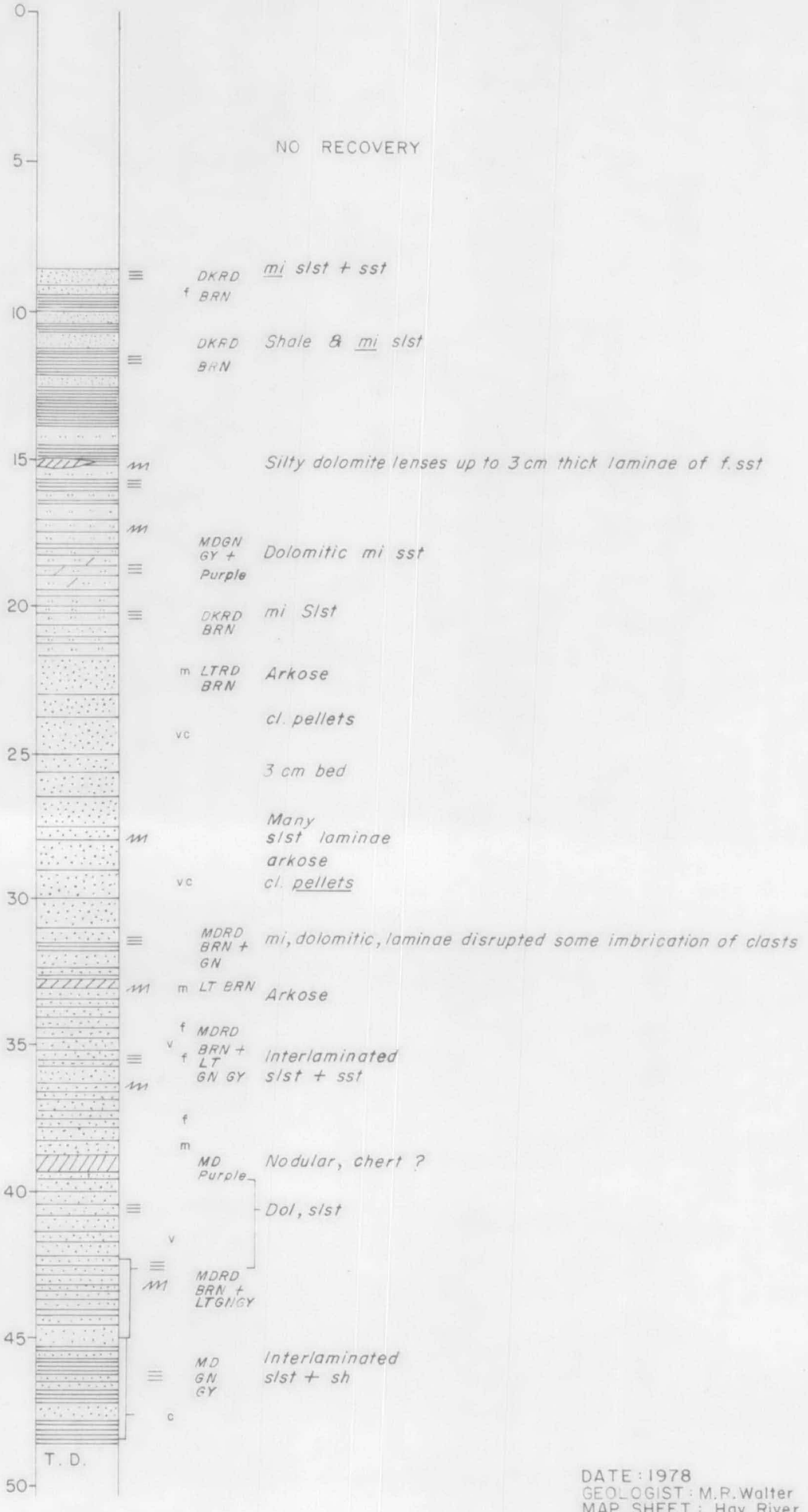
Fig. 6 Lithological log BMR Hay River No. 5



Record 1979/36

AUS 1/934

Fig. 7 Lithological log BMR Hay River No. 7

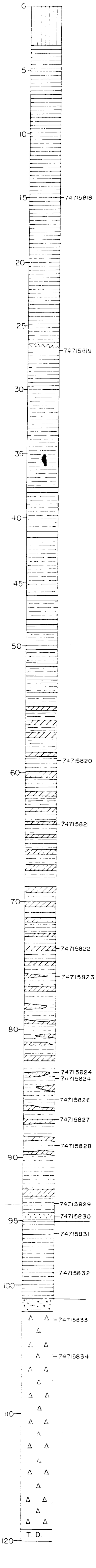


DATE : 1978
GEOLOGIST : M.R. Walter
MAP SHEET : Hay River
Scale : 1:200

Record 1979/36

AUS 1/935

Fig. 8 Lithological log BMR Hay River No. 8



≡RD, PPL Weathered slst

30°

Some gypsum veins on bedding planes up to 1cm thick

Highly fractured and rotten

DKGY + DKGN GY

Trace of limonite after sulphide

Lenses of c.gr to sst ?

DKGY ≡ Slst, carbonaceous diseminated by dolomitic

20°

Disrupted and folded lamination.
Veins of pyrite and ? chalcopyrite

Cone in cone structures in calcite

Sand dyke 30 cm deep, intensely folded indicating about 10 times reduction in thickness

5 cm laminate MDGY dolomite

Dolomite + cone in cone in calcite

From here down abundant dolomite beds and lenses 1-10 cm thick. Shown diagrammatically on log - too many for all to be shown.

Infrequent low-relief ripples

First coarsegrained pyrite. Increases down from this level. Usually with in dolomite lenses as veins

Cone in cone

Increasingly frequent MDGY unlaminated beds about 1cm thick with abundant fine pyrite

Much lamina disruption, numerous pyrite veins

DKGY Fragmental calcite layers, with pyritic rims around many fragments. Most clasts 1-2 mm, but reaching 1cm

Calcite veins

Pyrite very abundant

Dolomite becoming less abundant downward

DKGY Sandy shale
py

Interlaminated LTGY + DKGY shale. Much lamina disruption

≡

Sandy + gritty MDGY ≡ Shale

Veins of calcite sphalerite
py

DKGY

DATA: 1978
GEOLOGIST: M.R. Walter
MAP SHEET: Hay River
Scale: 1:200

Record 1979/36

AUS /936

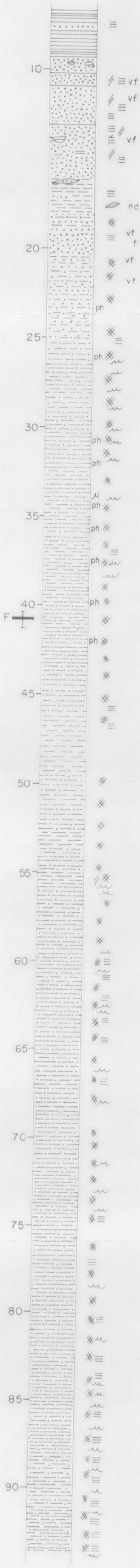
Fig. 9 Lithological log BMR Hay River No 10

DATA : 1978
GEOLOGIST : M.R. Walter
MAP SHEET : Hay River
Scale 1:200

AUS 1/937

Record 1979/36

Fig. 10 Lithological logs of BMR Hay River Nos. II, II_A and II_B



NO CORE

CUTTINGS – *fine grained multicoloured sst*

Cly pale brn claystone-slightly micaceus, silty thin silty sand laminae – core becames silty downward, tril brush marks in claystone

Gry yel grn dk brn sst Flaser to wavy bedding (lam thin bed size) and underlying claystone – possible Chondrites

Brn clay – rare sand lam – occasional thin sandy bed eroded upper and lower surface – sst – single lenticular bedding

Sst, f. grnd, impure, occasional layrs of clay galls

Sst, qtz – well developed streaming, parting lineation – grad contact overlying

Lt brn mdst, scour – fill

Sst – one crossbedded horizon marked by black minerals (heavy mineral conc) · rare clay pellets toward base – ≝ low & near base – outlined by dark minerals mdst – lent sst bedding

Sst – occas thin beds mdst with erosional lower layer of dark mineral. ? Ripple drift lamination, small scale lower and planar cross strat

One 15 cm thick bed flaser bedding zone Mn enrichment, equivalent to shot gun pellet

Occ clay pellet

Mottled siltst irregular lensoid sst beds; non rich patches (? weathered pyrite) ? bioturbation

Dk brn mottled mdst-vthin sst lenses ? bioturbation pyrite

Dk gry wspey wavy lam

Mixture siltst/sst – lenticular beds & patches sand wispy patches {*bioturbation abundant*

Patch of clay pellets infilling large burrow (sandy matrix {*hor + vert burrow pres.*

Grn gry sst grad contact with overlying siltst, pellets in sst matrix just above

sst bed – apparently massive sst – base has soft sediment deformation in mdst

Dk gry mdst/sst irregular lent bedding bioturbation abundant, veins gypsum

Dk gns mdst/sst lenticular wispy sst – bioturbation (diagenetic – secondary)

abundant sst beds are thin < 2cm pyrite Sst lam – wavy lam

Bioturbation less common, suggestion of ripple forms in some sst

Ripples lens sst two layers pellets (sst in clay matrix), in phosphatic calcareous matrix bioturbation present in more abundance

Sand content less than above – sst lensoid ripples minor bioturbation

Sst content increasing again (lens size also), bioturbation becoming more common – pellets in phosphatic matrix

Sst lens up to several cm thick, ripples – sole markings in sst

Sst lens up to 3cm thick pebble/pellet horizon ripples

Sst lens up to 5cm thick

Mainly mdst – < 10% sand, minor bioturbation

Sand content increased again, pellets in phosphatic matrix

Sand about 10% when sst is abundant bioturbation is more apparent

Sand content low

Sand content increased – abt bioturbation

Sand content variable

Pellets

Low sand content interval 40·59 – 41·00 m numerous slickensides *? Fault (shearing)*

Fossil fragment (pyrite)

Variable sst content, layer of pellets

Variable sst content fossil (small Lingula or ostracod) pyrite – single Xstal, aggregate of Xstals

Low sst small zones of slickenside, pyrite, fossil frag (? trilobites)

Low sst content pyrite

Low sst content very friable

" "

Sand content increasing pyrite F {*Impression of ? pelecypod frag*
Asaphid tril (core 174)
Chitinous fragment

Sand content low pyrite fossil frag. phosphatic Lingula

Sand content quite low pyrite rare chitinophos frag indet impressions (fragments)

Sand content low pyrite rare fragm. chitinous fragm.

Sand content increased markedly. Some Ssts have erosional contact with mica : chit frag. small pelecypod

Light sand content parting lineament in one sst bed

Pyrite, frag chitinous, indet impressions

Sst cont low, pyrite, frag chitinous indet impressions, pelecypod. Indet (? tril frag)

Some slickesides Tril. frag. : chitinous frag. indet frag. ? tril.

Sst still variable : indet fragments

Sst variable. Indet fossil frag (impressions) more common than previously, some chit.

Variable sst content, chitinous frag tril tail (Asaphid) ? shed exoskeleton

Sst content reduced, difficult core recovery, frag.

Variable sst content; linguloid, orthid brach/indet frag

Sst cont. increases; linguloid, Tril fragms/indet fragm

Sst variable, linguloid, Asaphid Tril frag/indet frag

Pyritized fossil. Asaphid tail (core 251), Orthid brach/indet frag

Less sand, tril fragm/indet fossils

Very little sand, pyrite, tril fragm/indet fragm

Pyrite, tril frag, /indet frag, brach (core 266)

Sand content increasing, rare indet fagm.

Sand variable, indet. fragm., tril. fragm.

Pyrite nodules 1cm across cubic face tril frag/indet frag ? linguloid frag

Little sand pyrite with fossils orthid brachs (2) tril fragm

Sand variable pyrite with fossils/indet fragm

Sand " " " " " " ? ostracod

Sand " " " " /indet fragm

Sand increasing, tril fragm/indet fragm

Sand variable/indet fragm

Sand variable pyrite – fossils/indet frag, orthed brachs, tril fragm

" " " " /indet frag, brachs

Sand increasing pyrite – fossils/indet fragm

" " pyrite/indet fragm

Sand increasing; patches filled with skeletal hash calcareous (pelecy) frag/indet frag

Sand variable skeletal frag, calc chit (indet)

Sand variable/indet fragm.

Pyrite nodule/cm across, tril frag, /indet frag.

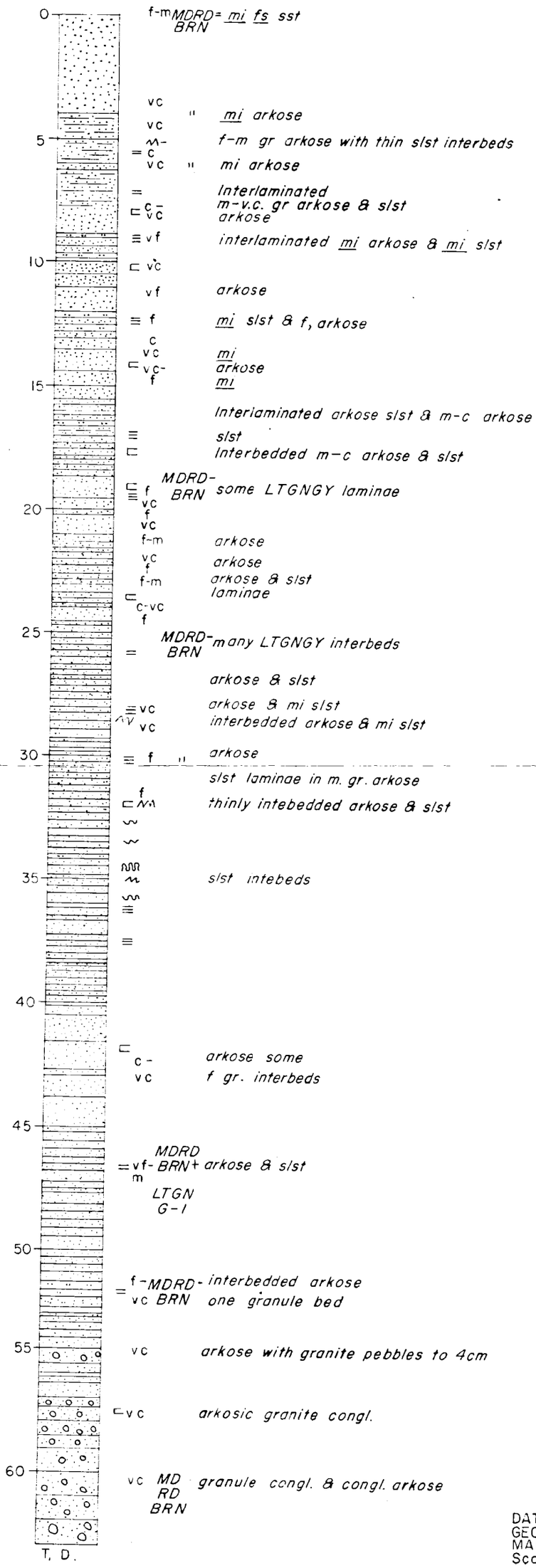
Very little sand/indet fragm.

DATA: 1978
GEOLOGIST: J.J. Draper
MAP SHEET: Mount Whelan
Scale: 1:200

Record 1979/36

AUS 1/938

Fig. 11 Lithological log of BMR Mount Whelan No. 1



DATA : 1978
GEOLOGIST : M.R.WALTER
MAP SHEET: Mount Whelan
Scale : 1:200

Record 1979/36

AUS I /939

Fig. 12 Lithological log BMR Mount Whelan No 2