OIL DEVELOPMENT NO LIABILITY

100 Collins Street,

MELBOURNE, C.1, VICTORIA.

COMPLETION REPORT

AUGER SAMPLING PROJECT, BATHURST ISLAND OIL PERMIT NO. 8, NORTHERN TERRITORY

by

R. HARE & ASSOCIATES

15th June, 1962

INTRODUCTION

A programme of auger sampling was carried out on Bathurst Island during the dry season of 1961 with the object of obtaining unweathered samples of Cretaceous sediments for biostratigraphic correlation based on foraminifera, and to determine the distribution of the Cretaceous sediments beneath the thin cover of Tertiary sands which masks the Cretaceous bedrock over practically the whole of the interior of the island.

As originally planned, the programme consisted of a series of traverses, for the most part following existing tracks, along which auger holes were to be sunk initially at intervals of one mile; these were to be infilled later with additional holes if the results were found to warrant it. Eight traverses were originally planned, involving a total of 130 auger holes at one-mile spacing; however, this was modified soon after the project was commenced when it was found that the thickness of Tertiary sands overlying the Cretaceous sediments was more than expected, and in many cases was greater than the depth capacity of the rig. Even in those holes in which Cretaceous sediments were met below the Tertiary sands, the auger could not penetrate sufficiently deeply to pass out of the weathered zone, from which all the calcareous foraminifera had been leached, leaving only a residue of arenaceous foraminifera after washing.

The programme was therefore modified, and the later drilling was conducted along the beaches of the western and southern coastline where the Cretaceous sediments are exposed in a number of places. The locations of all auger holes drilled are shown on Annex 1, together with other relevant data.

The faunas of all the fossiliferous samples are listed on the accompanying distribution chart. This chart shows that the faunas are rather poor both numerically and in species.

The decalcified remnant-faunas from the auger holes cannot be dated precisely by their contained species, as the shorter-ranging and more distinctive calcareous and aragonitic forms have been leached out. They can only be compared with the arenaceous elements of the assemblages from Wells No. 1 and 2, and be assessed in terms of likeness to or dissimilarity from the Cenomanian. On this basis it seems probable that the samples from holes D2 to D5 and A28 to A30 are Cenomanian. C5 to C8 samples are rather poorly fossiliferous but the species found in them are also found more frequently in samples from A28 to A30. As C5 and A28 are adjacent holes it seems most likely that all these holes enter one relatively high area of Cenomanian. Samples from D1 and A31, respectively adjacent to areas of probable Cenomanian, are quite possibly the same age, as the lithology of the samples resembles that of the Cenomanian. Sample F3, from the centre of the south-coast 2 miles south-west of Well No.2, contains a planktonic fauna consisting of Globigerina planispira Tappan, Praeglobotruncana stephani (Gandolfi) and Rotalipora cushmani (Morrow). This fauna is definitely Cenomanian. A benthonic fauna from the "Mission Sawmill" hole has been correlated with the upper part of the Cenomanian from Wells Nos. 1 and 2 (see O.D./63) and this accords with the presence of ammonites equivalent to those from just below the Tapara bed, found on the coast near the Mission by Dr. Brian Daily. Sample F1 is also possibly Cenomanian from its content, and its stratigraphic position makes this age probable.

The remaining samples are too poorly fossiliferous to be strictly comparable with the known Cenomanian. There is no reason to suggest that they are not Cenomanian, but not sufficient to suggest that they are. A14 is rather exceptional due to the proportions of its constituents differing from other samples, but it could still be Cenomanian. It is not possible to rule out the chance that foraminifera could be preserved in some part of the Turonian, and some of the poorer samples could be this age. Textularia cf. washitensis is the only foraminiferal species so far obtained from definite Turonian (in Well No.1).

The leaching of the Cretaceous sediments has proceeded to a greater depth than was anticipated from the study of the coastal sections, and it is now clear that further auger holes are unlikely to provide a justifiable amount of information. It seems that geophysical methods would need to be employed for inland mapping. The auger holes have shown a relatively high area of Cretaceous rocks in the vicinity of A30 to A28 and C5 to C8, but whether it is a closed high or not cannot be judged from the depleted and indistinctive fauna. The abrupt drop in level of the top of the Cretaceous between A28 and C4 suggests faulting on the south-east edge, at least (see O.D./76).

Mary Wade

Adelaide, 28th May 1962

Chart: Drg. No. OD/98. Distribution of foraminifera in samples from auger holes on Bathurst Island, O.P.8, Northern Territory.

Annex 3

Report on Foraminiferal investigation of samples from auger-holes sunk by Oil Development, N.L., on Bathurst Island, 1961 (O.P.8, Northern Territory)

by

Dr. Mary Wade

(University of Adelaide)

Early investigations of coastal samples from Bathurst Island showed a Cenomanian fauna of foraminifera and mollusca in the region between Mirialampi and Mirindow, on the south coast. Traced to the west, unfossiliferous and highly weathered sands and clays overlying the Cenomanian were found to contain Turonian mollusca. The correctness of this correlation was borne out by the superposition of Turonian (with Collignoniceras cf. woolgari and other mollusca) above Cenomanian in Well No.1, Ticklitipinapitta. Albian ammonites collected near Numungumpi, apparently in the midst of the Turonian sequence, are now considered to be derived. Several of numerous other coastal samples yielded only arenaceous (non-calcareous) foraminifera, as the strong lateritization of the Cretaceous rocks has obliterated fossils in many places, and left only the most resistant in others. In places there is a thick cover of unfossiliferous quartz sands. These are presumed to be of Tertiary age as they are unconformable on the Upper Cretaceous, and have undergone considerable erosion during the establishment of the present-day drainage system.

In an endeavour to penetrate the cover of lateritized rock and/or "Tertiary" sands, several traverses of auger-holes were run in the central part of the island, and in the centres of the south and west coasts. Holes were bored about one mile apart and to a maximum depth of 120'. The locations of the holes are shown on map O.D./75 together with a table of elevations, depths of holes, and reduced levels of the top of the Cretaceous when the latter was recognized in the field. Identifications of foraminifera show that the Cretaceous was also reached in holes A23, A28 and C5. As the samples were taken from the leading augers, it is to be supposed that the reduced level of the top of the Cretaceous approximates the bottom of these holes. 35 of the 81 holes penetrated Cretaceous, but the samples from only 3 holes, F1, F3 and "Mission Sawmill" (all on the south coast) were not completely decalcified.

. . . / 2

The project was commenced on 7th June, 1961, when the personnel, two four-wheel-drive vehicles and the auger drill were transported by lugger from Darwin to Bathurst Island; the project was eventually completed on 6th September, 1961.

DESCRIPTION OF AUGER DRILL

A trailer-mounted Gemco 110A auger drill was used; its depth limit under the conditions encountered on Bathurst Island was about 120 feet. This unit is light and readily manoeuverable, and it was easily towed by one four-wheel-drive vehicle over most of the area; however, especially in gaining access to the beaches, two vehicles together with block and tackle were required to negotiate steep grades.

Hollow augers, six feet long and $2\frac{5}{8}$-inches in diameter, were used, and the most successful results were obtained when a three-pronged $3\frac{1}{4}$-inch bit, tipped with tungsten carbide, was used on a solid leading auger.

SURVEY METHODS

The inland holes were located by tacheometric survey, using a C.T.S. theodolite. The datum for the horizontal survey was taken as the large mangrove tree on the west bank at the mouth of Pipianamilli Creek, and the survey was controlled for azimuth at holes C - 1 and C - 8 on tidal inlets and at B - 13 at Caution Point. The datum for elevations was taken as mean high tide level and the elevations were controlled at the same localities at sea level as for the azimuth control. The positions of the coastal holes, all sited at mean high tide level, were located from aerial photographs.

OPERATING METHODS

The project was carried out by one geologist-surveyor, three field assistants (one European, and two natives), and two drillers. The personnel worked out from a base camp located at the site of Bathurst Island Well No.2, on Pipianamilli Creek. As the vehicles could only travel at low speed, the drilling and survey parties both camped on the job for periods of up to one week, before returning to the base camp for additional supplies.

STATISTICAL DATA ON OPERATIONS

Period of project: 7th June to 6th September 1961, 92 days
Days worked, drilling: 59 days
Days worked, surveying: 45 days
Days lost: 18 days (owing to mechanical breakdowns of drill and vehicles, and moving camp)
Rest days: 15 days
Number of holes drilled: 69
Total footage drilled: 8,257 feet

SUMMARY OF GEOLOGICAL RESULTS

With the exception of D - 7, all of the auger holes drilled along the coastal traverses penetrated varying thicknesses of Cretaceous sediments (see Table on Annex 1), but only nine of the 79 auger holes drilled along the inland traverses passed out of the Tertiary sands into the underlying Cretaceous sediments. Five of these nine holes, however, are at the heads of tidal estuaries, and at elevations of only a few tens of feet above datum; the remaining four holes, A - 5, A - 29, A - 30, A - 31, passed respectively through 80, 60, 40, and 50 feet of Tertiary sands and penetrated 21, 23, 56 and 46 feet respectively of Cretaceous section. Paleontologic examination has shown that the Cretaceous was reached in three other wells in the interior of the island (A - 23, A - 28, C - 5), but the depth to the Tertiary - Cretaceous contact in these wells is not known. Elsewhere along the inland traverses, many of the wells were carried down to more than 100 feet without passing out of the Tertiary sands, but many others were stopped at much shallower depths by a hard indurated crust, or conglomerate and gravel, which is probably developed along the unconformity between the Cretaceous sediments and the overlying Tertiary sands.

From the evidence available, contours have been drawn on the top of the Cretaceous section, based on the datum of mean high water mark. As shown on Annex 1, these indicate a maximum topographic relief of about 200 feet or more on the Cretaceous erosion surface, but the slopes are apparently very gentle; although the slopes approach the scale of the present topographic relief of the island, they are not necessarily concordant with them, and the general pre-Tertiary drainage pattern may have differed from the present one.

Along the western coast of Bathurst Island in the vicinity of Cliff Island the relationship between the Tertiary sands and the underlying Cretaceous sediments can be seen in cliff sections, and was further revealed by the drilling of auger holes. As shown by the Longitudinal Section on Annex 2, the Cretaceous sediments consist of grey clay at the exposed base that grades upward to white clays and siltstones which contain interbeds of ferruginous sandstone. The surface of the Cretaceous is undulating, and channels have been eroded in it prior to the deposition of the Tertiary basal conglomerate and overlying sands, which cap the topographically high areas of the exposed Cretaceous sediments and infill the deeper channels which were eroded to a substantial depth below the present sea level.

The thickness of the Tertiary sands proved to be greater than was anticipated, and the unweathered zone of the Cretaceous sediments from which the calcareous content had not been entirely leached out, was only reached in two auger holes in the central part of the south coast (F - 1 and F - 3) and the auger hole at the Mission Sawmill. However, residues of identifiable arenaceous foraminifera were obtained from at least twenty-two other auger holes, including the four holes in the interior of the island which reached the Cretaceous section.

The paleontologic examination of the samples from the auger holes (see Annex 3) suggests that the Cretaceous wherever penetrated could probably all be of Cenomanian age. The assemblages found in the

samples proved to be too poor both numerically and in number of species to provide a basis for correlation with the assemblages found in Bathurst Island diamond drill holes Nos. 1 and 2, so that no definite correlation was possible between the assemblages from the auger hole samples and those of the diamond drill holes. However, as it seems probable that most, if not all, of the auger hole samples are of Cenomanian age, it is evident that if any structure exists in the Cretaceous sediments underlying the Tertiary sands, the degree of folding or tilting, if any, must be very slight, and any possible faulting would have resulted in quite small displacement.

LIST OF ANNEXES

Annex 1. Drawing No. OD/75. Bathurst Island auger hole data and contours on Cretaceous-Tertiary contact.

Annex 2. Drawing No. OD/77. Geology of the Clift Island area.

Annex 3. Report on Foraminiferal Investigation of Samples from auger holes sunk by Oil Development N.L. on Bathurst Island, 1961.

R. HARE & ASSOCIATES

15th June, 1962

130°00'

130°30'

11°30'

11°50'

TIMOR SEA

THE NARROWS

ST. ASAPH BAY

SHARK BAY

Deception Pt.

Caution Pt.

Culgurungini Ck.

Rocky Pt.

Wongaroo Beach

CLIFT IS.

Wargil Beach

GORDON BAY

Cape Helvetius

Pt. Fawcett

Cape Fourcroy

BOWEN BAY

One Tree Pt.

Lubra Pt.

BATHURST ISLAND WELL No.1

GARDEN PT. MISSION

HARRIS I.

Durham Pt.

APSLEY STRAIT

BATHURST ISLAND WELL No. 2

Pipianamilli

Moantu Ck.

Moonkinu Beach

MEDINA INLET

Mission Sawmill
BATHURST ISLAND MISSION

SHOAL BAY

-50

-100

HOLE No.	ELEVATION in feet	DEPTH in feet	REDUCED LEVEL top of Cretaceous
A 1	241	87	
A 2	251	93	
A 3	254	101	
A 4	191	101	
A 5	180	101	100
A 6	233	101	
A 7	149	51	
A 8	134	54	
A 9	192	84	
A 10	188	84	
A 11	71	84	
A 12	185	84	
A 13	69	48	
A 14	34	84	-20
A 15	89	72	
A 16	82	43	
A 17	111	60	
A 18	172	96	
A 19	179	96	
A 20	255	33	
A 21	247	96	
A 22	207	11	
A 23	199	48	
A 24	147	96	
A 25	120	96	
A 26	106	96	
A 27	88	96	
A 28	87	96	
A 29	114	83	54
A 30	82	96	42
A 31	174	96	124
A 32	312	96	
A 33	288	70	
A 34	275	63	
A 35	267	102	
A 36	219	102	
A 37	226	55	
A 38	200	102	
A 39	120	84	
A 40	107	48	
A 41	169	88	
A 42	116	92	
A 43	79	102	
A 44	83	102	
A 45	73	102	
B 1	174	63	
B 2	145	60	
B 3	100	52	
B 4	95	63	
B 5	95	120	
B 6	92	120	
B 7	70	94	
B 8	60	120	
B 9	52	64	
B 10	45	55	
B 11	50	81	
B 12	52	78	
B 13	25	118	
C 1	0	113	-80
C 2	25	120	
C 3	26	120	
C 4	22	120	
C 5	84	120	
C 6	43	120	-11
C 7	32	120	-54
C 8	20	120	-64
D 1	0	120	-40
D 2	0	120	-80
D 3	0	120	-73
D 4	0	120	-48
D 5	0	120	-80
D 6	0	120	-80
D 7	0	120	
D 8	0	120	-40
D 9	0	120	-30
D 10	0	32	-30
D 11	0	108	-40
D 12	0	31	-30
D 13	0	114	-70
E 3	36	120	6
F 1	0	120	-80
F 2	0	120	-10
F 3	0	120	-15
F 4	0	120	-80
F 5	0	120	-35
F 6	0	120	-25
F 7	0	120	-15
F 8	0	120	-18
WELL 1	2	828	0
WELL 2	83	1024	52
SAWMILL	20	96	10

SCALE OF MILES

2 0 2 4

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BATHURST ISLAND AUGER HOLE DATA

AND CONTOURS ON CRETACEOUS - TERTIARY CONTACT

(CONTOUR INTERVAL- 5 FEET.)

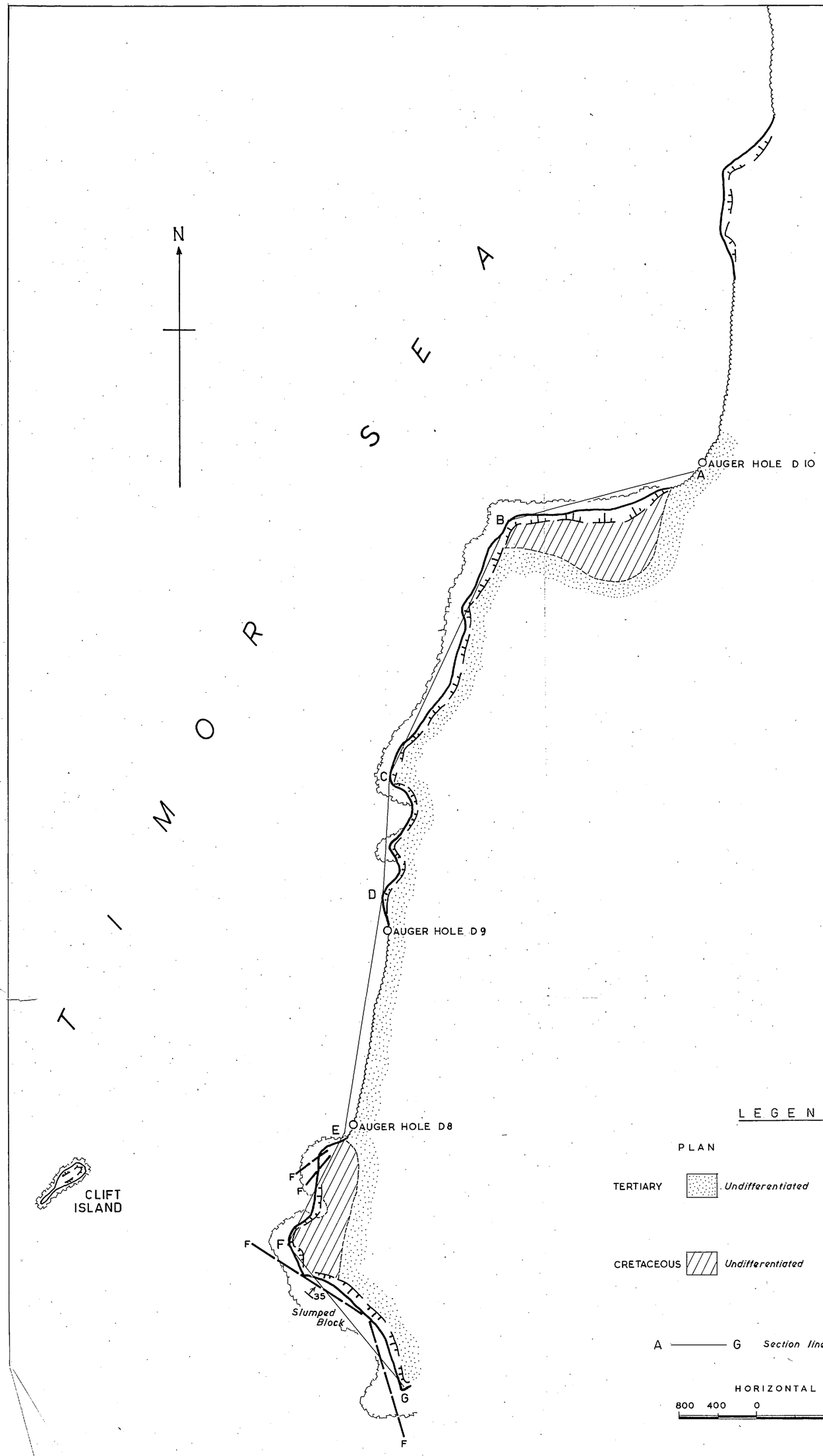
R. HARE & ASSOCIATES

SCALE: 2 Miles to an inch

Prepared: K. FLETCHER	REVISION
Drawn: I. R.	
Date: 9. 1. 62.	

DRG. No. O.D./75

WITH DATA FROM DRG. No. O.D./76 ADDED



LEGEND

PLAN

TERTIARY — Undifferentiated

CRETACEOUS — Undifferentiated

SECTION

- Sand
- Basal conglomerate and gravel
- Ferruginous sandstone
- White clay and siltstone
- Grey clay with purple stains.

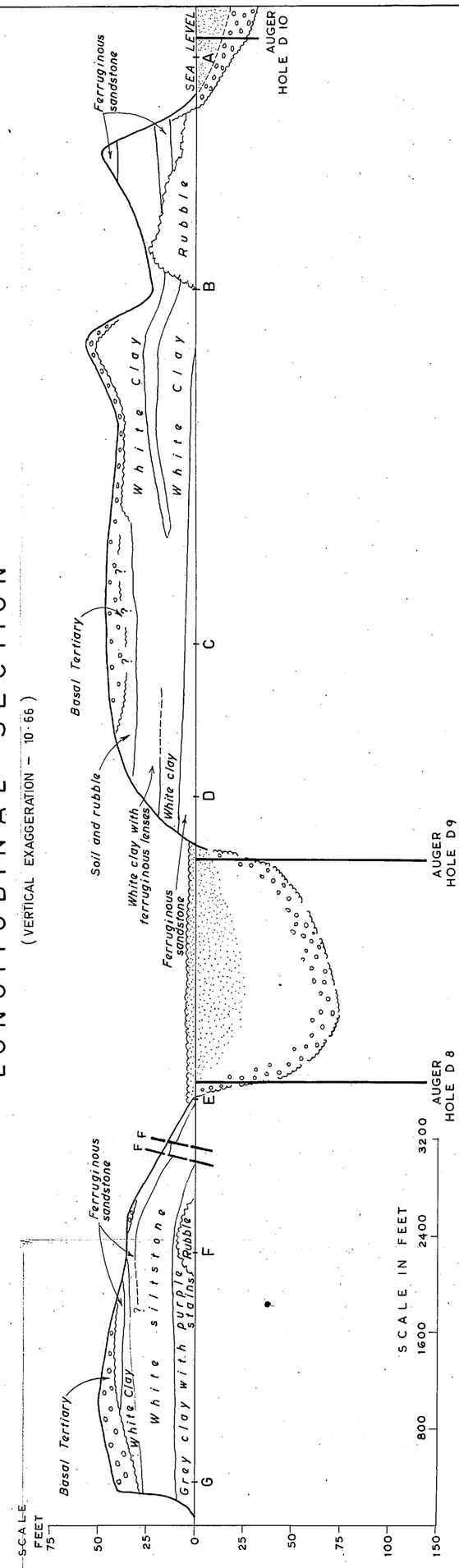
A ——— G Section line

HORIZONTAL SCALE

800 400 0 800 1600 Feet

LONGITUDINAL SECTION

(VERTICAL EXAGGERATION – 10·66)



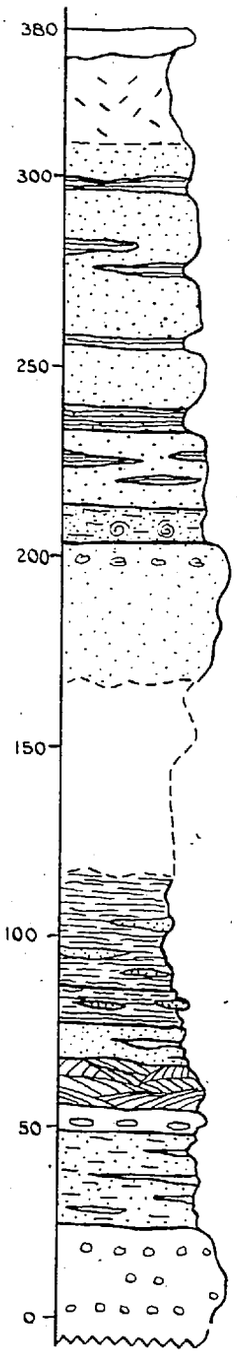
OIL DEVELOPMENT N. L.

OIL PERMIT No.8, NORTHERN TERRITORY

BATHURST ISLAND

GEOLOGY OF THE CLIFT ISLAND AREA

R. HARE & ASSOCIATES		SCALE VERTICAL 1"= 50 Ft. HORIZONTAL 1=800 "
Prepared: K. FLETCHER	REVISION	DRG. No. O.D./77
Drawn: I.R.		
Date: 12. 1. 62.		



30	Lateritic profile in Clays
70	Interbedded argillaceous Silty & Sandy Sediment
7	Glauconitic Sands
18	Glauconitic Clays & Sands interbedded
8	Glauconitic Sand & Clays with bedded Ammonites.
35	Glauconitic Sands, pyrite nodules consolidated, sands & Ammonites, Gastropods, Bivalves
50	
30	Glauconitic Clays with thin Sands, Lignitic particles, Ferruginous nodules.
9	Glauconitic Clays with thin Sands, Acanthoceras, Inoceramus.
8	Glauconitic Sands with thin Clays.
11	Strongly cross bedded Glauconitic Sands, Ferruginous nodules Acanthoceras, Baculites, etc.
5	Glauconitic Sands, crossbedded, Ferruginous nodules, Acanthoceras Hamites, Baculites etc.
25	Interbedded Glauconitic Sands, Clays, Flattened Ferruginous concretions, Fossils as above.
15-25	Interbedded Clays & Sands with Concretions 2' across, Baculites, Belemnites & Gastropods.

BATHURST ISLAND N.T.

Composite Log of Strata along South Coast of Bathurst Island

(After B. Daily 1955)

Scale 50 ft. : 1in.

Plan Prepared by Geosurveys of Aust. Ltd.

SAN 88

	A 5	A 14	A 23	A 28	A 29	A 30	A 31	B 8	C 1	C 5	C 6	C 7	C 8	D 1	D 2	D 3	D 4	D 5	D 8	D 9	D 13	E 1	E 2	E 3	F 1	F 2	F 3	F 5	F 6	F 7	F 8	F 9	MISSON SANHILL
Textularia sp.		o																															
T. washitensis			cf		△	□	□			△			?	o		△		△	o						?		cf	cf	?		cf.1	?	cf.	cf
Haplophragmoides sp.			△																														
Trochammina cf. depressa			△					△		o										?		o											o
Reophax			□		?		?		?			?	?	?			?														?		
Ammobaculoides ?			o			△										?																	
Bathysiphon			?		?	?	△										o	△	△												?		
Haplophragmoides sp. 2				o	□	□	□				cf.	cf.	cf.	cf.	cf	□	△	□	□							?				?			△
Dorothia filiformis				o	□	□	□				?	o	△	△		△	?	□	△						?								?
Trochammina sp.					o						o						o	o															
Textularia sp.2					△							o						△	o												cf.		
Haplophragmoides					?	?				⊙										?		o						?					
Marssonella cf. oxycona					o	o	o							o				△	o														
Textularia rioensis			?			o				?																							
Haplophragmoides sp. 1						o	?								△	?																	△
Trochammina sp.1						△	o								aff.									o									△
Ammobaculites sp.						△										juv																	
Trochammina sp. 4								□							□																		
" sp. 5								□							△																		
Haplophragmoides sp.7								□							□					?	?												
Gaudryina sp. (juvenile)														o																			
Trochammina sp.3																o																	
Haplophragmoides sp.3																△	o																
Textularia sp.1																		o										o			o		
Ammobaculites cf. albertensis																	o																
Ammobaculites sp.																						o	o		o	o							△
Lenticulina sp.																									o		△						△
Globigerina planispira																									o		△						o
Saracenaria triangularis																									o		o						
Praeglobotruncana stephani																											△						
Rotalipora cushmani																											o						
Gyroidinoides cf. nitidus																											△						□
Lenticulina cf. gaultina																																	△
Conorboides sp. nov.																																	△
Höglundina chapmani																																	□
Bulimina cf. nannina																																	□

o *Rare (1–2 specimens)*

△ *Few (3–6 specimens)*

□ *Frequent (7 specimens)*

? *Uncertain identification (usually due to crushing)*

[?] " " *of a frequent species*

DETERMINATIONS BY DR. M. F. GLAESSNER & DR. M. WADE, 1962

OIL DEVELOPMENT N.L.

OIL PERMIT No. 8. NORTHERN TERRITORY

BATHURST ISLAND

FORAMINIFERAL DISTRIBUTION CHART

DISTRIBUTION OF SPECIES IN SAMPLES FROM AUGER HOLES

R. HARE & ASSOCIATES

Drawn: I. R.

Date: 11. 6. 62.

DRG. No. O.D./98