PROCEEDINGS OF THE SIXTH SYMPOSIUM ON THE GEOLOGY OF THE BAHAMAS

Edited by

Brian White

Production Editor

Donald T. Gerace

Bahamian Field Station
San Salvador, Bahamas
1993

Printed in USA by Don Heuer

ISBN 0-935909-43-5

THE PETROLOGY OF BAHAMIAN PLEISTOCENE EOLIANITES AND FLANK MARGIN CAVES: IMPLICATIONS FOR LATE QUATERNARY ISLAND DEVELOPMENT

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ABSTRACT

Formation of Bahamian Pleistocene eolian ridges, and the phreatic dissolution caves (flank margin caves) within them, is linked to Quaternary sea-level history. Petrologic analyses of cave and surface rock samples from five Bahamian islands reveal that the dominant allochems in the rocks that comprise the cave walls are peloids and bioclasts, and oöids are conspicuously absent. Samples from measured sections of outcrops located on the surface of the eolian ridges reveal that the ridges can be classified into four types based on allochem composition: peloidal-bioclastic, oölitic, peloidal-bioclastic transitional upward to oölitic, and peloidal-bioclastic unconformably overlain by oölitic.

Most cave wall samples are moderately well cemented with micrite and spar. In some caves however, the rock is extremely friable; petrologic analyses of those samples showed the allochems to be cemented by only a thin coating of circum-granular sparry calcite crust. Cements seen in samples from exterior ridge outcrops vary from marine phreatic to vadose types, depending on location and allochem composition. Rocks which are oölitic appear to be cemented exclusively by equant spar; whereas peloidal-bioclastic rocks tend to be cemented by microcrystalline cements or by circum-granular crust cements.

The majority of caves formed during oxygen isotope substage 5e. Only two known caves formed in intertidal oölitic deposits, and that development was probably nearly synchronous with build-up of the oölitic eolian ridges. All other caves formed within older peloidal and bioclastic eolianite deposits. The variability of petrology seen among samples from the same eolianite ridge, as well as the variability between ridges, and the onlap and overlap of eolianites deposited during different sea-level highstands, suggests that random surface sampling and morphostratigraphy alone are insufficient to reliably unravel the Quaternary history of Bahamian eolianites. Only detailed sampling along measured sections on both faces of the ridges, and where available, sampling from caves within the ridges is likely to lead to successful understanding of the geology of the Bahamian islands.

INTRODUCTION

Vogel and others (1990) speculated that evidence of past sea-level highstands of the late Pleistocene should be reflected in the petrology of the eolianite sand bodies and the walls of the flank margin caves (Mylroie and Carew, 1990) in the interior and coastal areas of San Salvador Island and elsewhere in The Bahamas. There should be diagenetic markers within the carbonate grains and cements that reflect different sea-level highstands and consequent platform flooding. Earlier study of the Pleistocene eolianites of San Salvador had revealed some of the variability within and among ridges (Hutto and Carew, 1984), but it was thought that a more thorough examination of some of the deposits, there and elsewhere, might provide information that could help to determine the details of the diagenetic environment(s) to which they were subjected. The purpose of this study then was to follow-up on Vogel and others (1990) by analyzing in detail the wall rock from a few select horizontal dissolution caves to determine whether a phreatic fresh-water diagenetic signature could be identified, and to search for evidence of marine phreatic and mixing-zone diagenesis in Pleistocene eolian calcarenite ridges. To those ends we conducted detailed quantitative petrologic analyses of oriented hand samples of Pleistocene eolianites and cave wall rocks, and conducted x-ray diffraction analyses of selected samples.

Methods

Point counts were conducted on a total of 249 thin sections that were produced from oriented samples; fifty-one (51) were from flank margin caves on New Providence, San Salvador, and Long islands; and 198 were from eolianite ridges on South Andros, New Providence, San Salvador, Long, and Great Inagua islands (Figure at front of this volume). Samples collected on South Andros, New Providence, Long, and Great Inagua islands were not systematically collected along measured sections. Samples collected from San Salvador Island were recovered along detailed measured transects. Samples were impregnated with blue-tinted Petropoxy 154 in order to determine the amount and character of porosity. Twenty-two samples were analyzed by XRD to determine their mineralogic composition.

RESULTS

Cave Samples

Most of the allochems seen in these cave samples were assigned to one of three general categories: oölitic, non-oölitic (bioclasts, peloids, etc.), and orthochem (micrite). All of the cave samples fell into the non-oölitic category as they are largely peloidal and bioclastic, and oöids are very rare (Table 1). Vogel and others (1990) reported some oöids in the wall rock of some caves on San Salvador, but reassessment of those thin sections has revealed that the allochems previously identified as oöids are transverse sections of serpulid worm tubes or vermetid gastropods. While some cave wall samples contain little cement, most cave samples are well cemented with micrite, and in a few cases by spar cement (Table1), but a few caves exhibit more eclectic cementation discussed below.

Samples taken along a measured transect from the Aeolian Room, the main chamber of Lighthouse Cave (Figure 1), and a room toward the back of the Waterloop, contain a variety of cementation styles. Samples collected within the Waterloop, and currently in contact with marine water, have pronounced isopachous cements. The porosity of these samples is very low. In contrast, samples collected just above mean sea level have very reduced isopachous cements and noticeably greater porosity. The vertical distance between those sample sites is only 0.67 meter. Samples collected still farther up this measured section contain fresh-water vadose calcite cements, especially circum-granular crusts (Moore, 1989, p. 183, fig. 7.4A) on the allochems. Samples recovered at ceiling level contain fresh-water vadose cements and still greater porosity.

The Aeolian room of Lighthouse Cave exhibited a slightly different cementation pattern. The lowest sample, recovered from an area which is usually dry, but may flood during unusually high tides or storm surges, has reduced isopachous cements with a pronounced fringe of dog-tooth spar. Above the mean high tide stain, the samples have no isopachous cement, but instead have circum-granular spar crusts and high porosity. Ceiling samples here contained some fresh-water vadose cements. George Storr's Cave (Figure 2) and Garden Cave contain virtually the same cement distribution as the samples collected in the Waterloop of Lighthouse Cave, except that the low samples from George Storr's and Garden Cave do not contain isopachous cements. The lower portions of these caves are dry and do not flood, as they do not extend below +1 meter elevation.

The wall rock of Reckley Hill Pond Cave (Figure 3) is extremely friable and gypsum crystals occur low on the ceiling and walls of this cave. The wall rock is cemented by a thin circum-granular crust of calcite on the grains. The isotopic composition of that gypsum indicates bacterial mediation of its formation (Bottrell, and others, this volume).

XRD data was obtained on samples from five San Salvador caves, two New Providence caves, and from one cave on Long Island. The sample from the Waterloop in Lighthouse Cave that is currently in contact with marine water contained 5.12% dolomite. The sample taken 0.67 meter above that sample contained no dolomite. Among the samples analyzed from four other San Salvador caves, Emerald Cave, Crescent Top Cave, Midget Horror Hole, and Pipe Cave, only the Emerald Cave sample contained dolomite (4.25%).

Samples from Salt Pond Cave, Long Island contain 3.26% dolomite, and on New Providence Island, samples from Bat Cave contain 4.90% dolomite, and those from Harry Oakes cave contain 3.62% dolomite. The presence of dolomite in these cave

San Salvador Caves		oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity	rock name	exact elevation	est. elevation
CRESCENT TOP CAVE #1	SS	0	56	5	3	0	3	0	0	6	6	1	0	0	23	3	26	Pelbiosparite	.33m / 1.1ft	
CRESCENT TOP CAVE #2	SS	0	82	0	0	0	1	0	0	1	12	0	0	0	5	0	5	Pelsparite	.66m / 2.2ft	
CRESCENT TOP CAVE#3	SS	0	71	0	0	0	0	0	0	0	21	0	0	0	8	0	8	Pelsparite	.99m / 3.2ft	
DANCE HALL CAVE #1	SS	0	0	43	2	0	5	0	0	7	2	17	0	0	23	8	31	Poorly Washed Biosparite	1.9m / 6.1ft	
DANCE HALL CAVE#2	SS	0	50	6	0	0	0	0	0	0	0	0	0	0	31	13	44	Pelmicrite	2.2m / 7.1ft	
DANCE HALL CAVE #3	SS	0	38	11	0	3	0	0	0		1	12	0	0	31	4	35	Pelbiomicrite	2.5m / 8.2ft	
EMERALD CAVE #1	SS	0	29	46	0	0	5	0	0	5	0	2	0	0	18	0	18	Poorly Washed Pelbiosparite	3.2m / 10.3ft	
EMERALD CAVE #2	SS	0	54	0	0	0	0	0	0	0	1	5	0	0	31	9	40	Pelbiosparite	3.0m / 9.8ft	
GARDEN CAVE #1	SS	0	0	0	2	0	0	0	0	2	24	74	•	•	0	0	0	Biomicrite	2.8m / 9.4ft	
GARDEN CAVE #2	SS	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	Micrite	3.1m / 10.1ft	
GEORGE STORRE'S CAVE #1-1	SS	0	29	17	0	0	12	0	0	12	26	6	0	0	4	6	10	Pelbiosparite	1.8m / 5.9ft	
GEORGE STORRE'S CAVE #1-2	SS	0	43	30	1	0	5	0	0	6	1	3	0	0	17	0	17	Pelbiosparite	1.9m / 6.3ft	
GEORGE STORRE'S CAVE #1-3	SS	0	15	30	1	0	14	1	0	16	2	7	•	•	26	4	30	Pelbiosparite	2.1m / 6.9ft	
GEORGE STORRE'S CAVE #2-1	SS	0	31	19	3	0	0	0	0	3	1	11	0	0	31	4	35	Pelbiosparite	1.8m / 5.9ft	
GEORGE STORRE'S CAVE #2-2	SS	0	0	•	16	0	5	5	0	26	0	16	•	•	45	11	56	Biosparite	2.14m / 7.0ft	
GEORGE STORRE'S CAVE #2-3	SS	0	28	8	8	0	15	1	1	25	0	8	0	0	27	4	31	Poorly Washed Pelbiosparite	2.3m / 7.5ft	
GEORGE STORRE'S CAVE #3-1	SS	0	35	23	0	0	1	0	0	1	4	27	0	0	9	1	10	Poorly Washed Pelbiosparite	3.3m / 10.8ft	
GEORGE STORRE'S CAVE #4-1	SS	0	35	16	6	0	1	1	0	8	2	5	0	0	34	0	34	Pelbiosparite	1.5m / 4.9ft	
LIGHTHOUSE CAVE 91-1	SS	0	0	66	0	0	0	0	0	•	7	0	0	0	14	13	27	Poorly Washed Biosparudite		.25m / .82ft
LIGHTHOUSE CAVE 91-2	SS	0	0	51	0	0	0	0	0	•	0	•	0	0	34	15	49	Biomicrudite		1.45m / 4.8ft
LIGHTHOUSE CAVE 91-3	SS	0	21	40	1	0	0	0	0	1	8	0	0	0	28	2	30	Poorly Washed Biosparudite		2.7m / 8.7ft
LIGHTHOUSE CAVE 91-4	SS	0	8	50	0	0	0	0	0	•	28	0	0	0	14	0	14	Poorly Washed Biosparudite		
LIGHTHOUSE CAVE 91-5	SS	0	0	53	0	0	2	0	0	2	25	0	0	•	11	9	20	Poorly Washed Biosparudite		5.1m / 16.6ft
LIGHTHOUSE CAVE 91-6	SS	0	0	65	5	0	1	0	0	6	12	0	0	0	17	0	17	Poorly Washed Biosparudite		6.3m/20.5ft
LIGHTHOUSE CAVE 92-1	SS	0	30	2	22	3	5	0	0	27	10	4	0	0	15	9	24	Poorly Washed Biosparudite	-.93m / -.28ft	
LIGHTHOUSE CAVE 92-2	SS	0	2	8	50	0	1	0	0	51	23	0	0	0	18	0	18	Poorly Washed Biosparudite	-.50m / -.15ft	
LIGHTHOUSE CAVE 92-3	SS	0	18	14	20	0	0	5	19	44	5	0	0	•	19	0	19	Biopelsparudite	.17m / .56ft	
LIGHTHOUSE CAVE 92-4	SS	0	11	33	10	0	0	0	2	12	0	0	0	•	36	8	44	Pelbiosparudite	.74m / 2.43ft	
LIGHTHOUSE CAVE 92-5	SS	0	5	26	11	1	6	0	1	18	•	0	0	0	37	13	50	Biopelsparudite	1.4m / 4.6ft	
LIGHTHOUSE CAVE 92-6	SS	0	8	30	6	0	0	0	3	9	7	0	0	0	19	27	46	Clotted Pelbiosparudite	2.4m / 7.9ft	
LIGHTHOUSE CAVE 92-7	SS	0	22	16	27	0	•	0	1	28	•	0	0	•	32	2	34	Biopelsparudite	2.95m / 9.7ft	
MIDGET HORROR HOLE #1	SS	0	12	32	0	0	7	0	0	7	0	0	0	0	49	0	49	Clotted Pelbiosparite	5.0m / 16.4ft	
PIPE CAVE #1	SS	0	62	0	0	0	0	0	0	0	9	0	0	0	28	1	29	Pelbiosparite	3.6m / 1.0ft	
RECKLEY HILL POND CAVE 91-1	SS	0	17	21	0	0	1	0	0	1	3	2	0	0	51	5	56	Pelbiosparite	.	.94m / 3.1ft
RECKLEY HILL POND CAVE 91-2	SS	0	12	17	0	0	2	0	0	2	1	3	0	0	62	3	65	Pelbiosparite		1.7m / 5.7ft
RECKLEY HILL POND CAVE 91-3	SS	0	14	43	0	0	0	0	0	0	•	0	0	0	36	7	43	Clotted Pelsparite		2.5m / 8.3ft
RECKLEY HILL POND CAVE 91-4	SS	0	5	40	2	0	0	0	0	2	•	0	0	0	45	8	53	Clotted Pelsparite		3.3m / 10.9ft
RECKLEY HILL POND CAVE 91-5	SS	0	7	50	2	0	3	0	0	5	•	0	0	0	35	3	38	Clotted Biopelsparite		4.1m / 13.6ft
RECKLEY HILL POND CAVE 92-1	SS	0	2	50	1	0	3	0	0	4	•	0	0	0	35	9	44	Clotted Biopelsparite	0 m / 0 ft	
RECKLEY HILL POND CAVE 92-2	SS	0	3	34	1	0	2	0	0	3	1	0	0	0	47	12	59	Clotted Pelsparite	1.0m / 3.3ft	
RECKLEY HILL POND CAVE 92-3	SS	0	2	49	•	0	•	0	0	0	•	0	0	0	42	7	49	Clotted Biopelsparite		2.6m / 8.4ft
RECKLEY HILL POND CAVE 92-4	SS	0	1	30	3	0	6	0	0	8	•	0	0	0	52	9	61	Clotted Biopelsparite		4.2m / 13.7ft
SLIVER CAVE #1	SS	0	0	0	0	0	3	0	0	3	3	83	0	0	11	0	11	Pelmicrite		5.0m / 16.4ft

Table 1a Point count data (%) of cave samples from San Salvador.

New Providence Caves	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity	New Providence Caves	rock name	estimated elevation
Bahamas West Cave #1	0	40	46	0	0	0	2	0	0	3	7	0	0	2	0	2	Bahamas West Cave #1	Pelmicrite	5.5m/18.0ft
Bahamas West Cave #2	0	35	17	0	0	1	0	0	0	2	3	0	0	33	9	42	Bahamas West Cave #2	Pelbiomicrite	2.55m/8.4ft
Bat Cave	0	3	0	0	0	40	0	0	40	0	30	0	0	22	5	27	Bat Cave	Biomicrite	4.3m/13.9ft
Harry Oak's Cave #4	0	25	0	0	0	0	0	0	0	0	83	0	0	1	0	1	Harry Oak's Cave #4	Pelmicrite	3.0m/9.8ft
Harry Oak's Cave #5	0	24	32	2	0	3	1	0	10	10	1	0	0	26	1	27	Harry Oak's Cave#5	Pelsparite (Clotted Micrite)	3.0m/9.8ft
Harry Oak's Cave #6	0	47	6	1	0	1	0	0	0	1	0	0	•	44	0	44	Harry Oak's Cave #6	Pelsparite (Clotted Micrite)	3.5m/11.5ft
Hunt's Cave #1	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	Hunt's Cave #1	Micrite	4.8m/15.7ft

Long Island Caves	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity	Long Island Caves	rock name	estimated elevation
Salt Pond Cave	0	9	1	15	0	16	0	1	32	3	1	0	0	39	15	54	Salt Pond Cave	Poorly Washed Biopelsparite	3.5m/11.5ft

Table 1b Point count data (%) of cave samples from Long and New Providence islands.

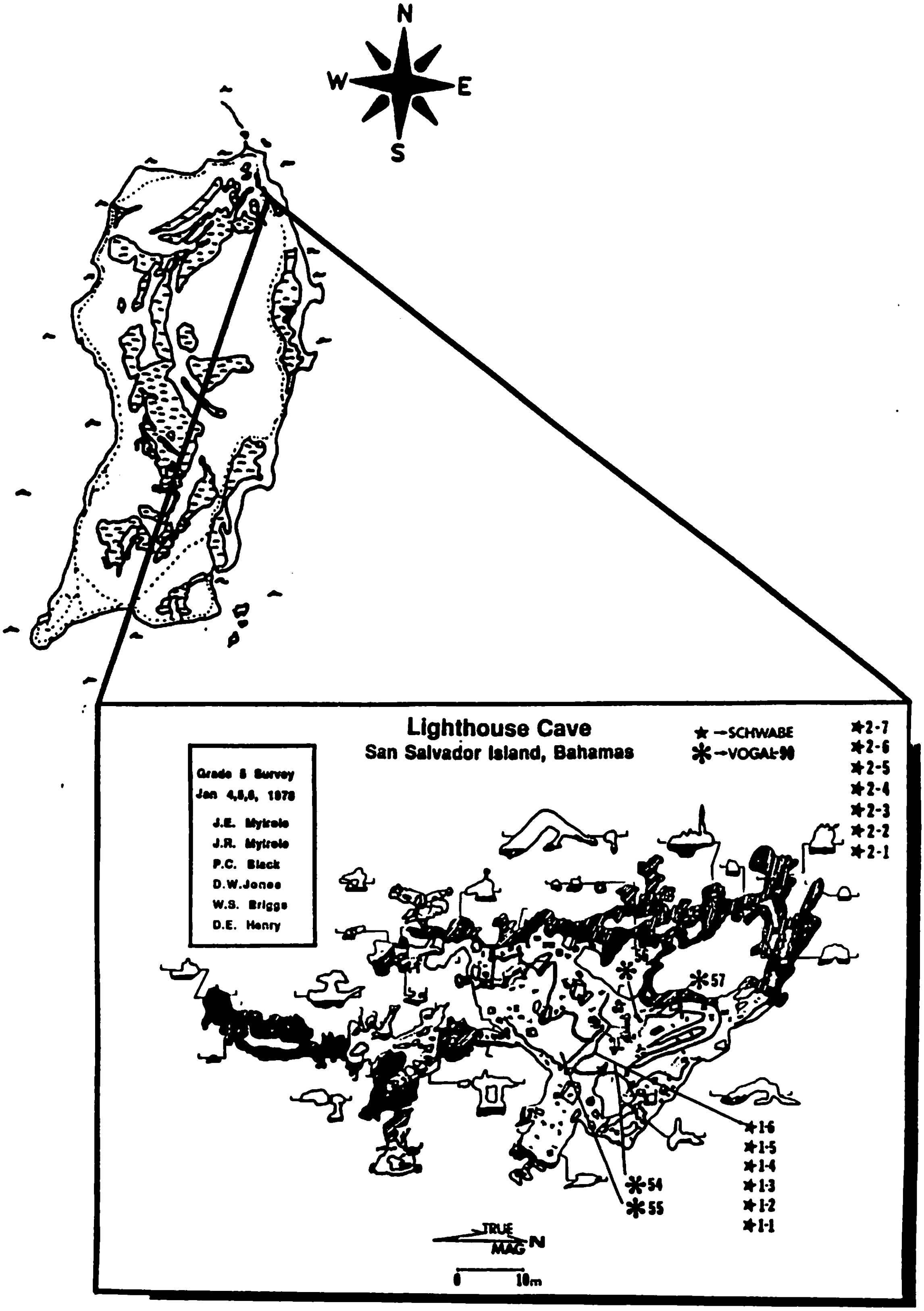

Figure 1. Map of Lighthouse Cave within Dixon Hill showing sample localities, and the location of the cave on San Salvador.

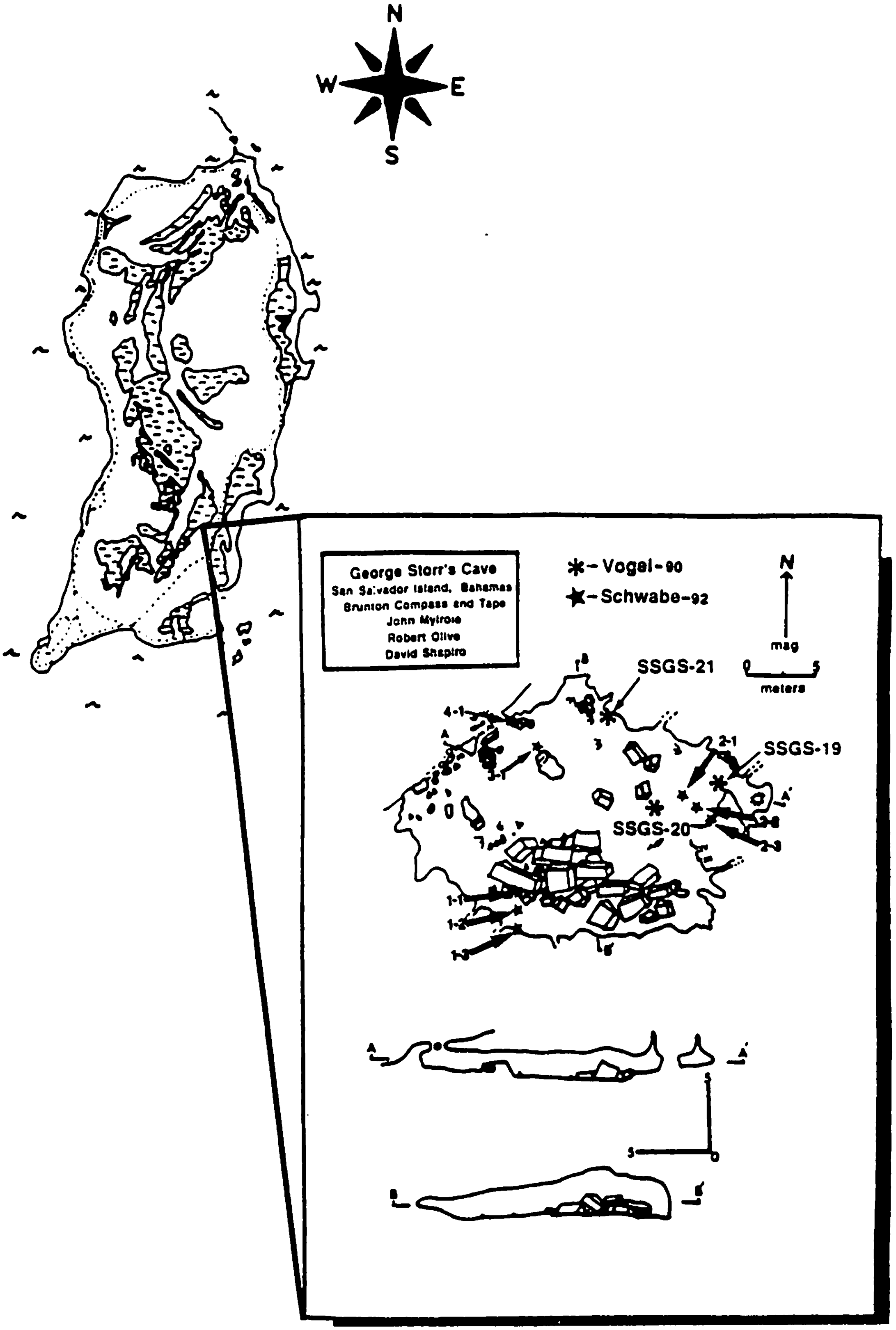

Figure 2. Map of George Storr's Cave showing sample locations, and the cave's location on San Salvador.

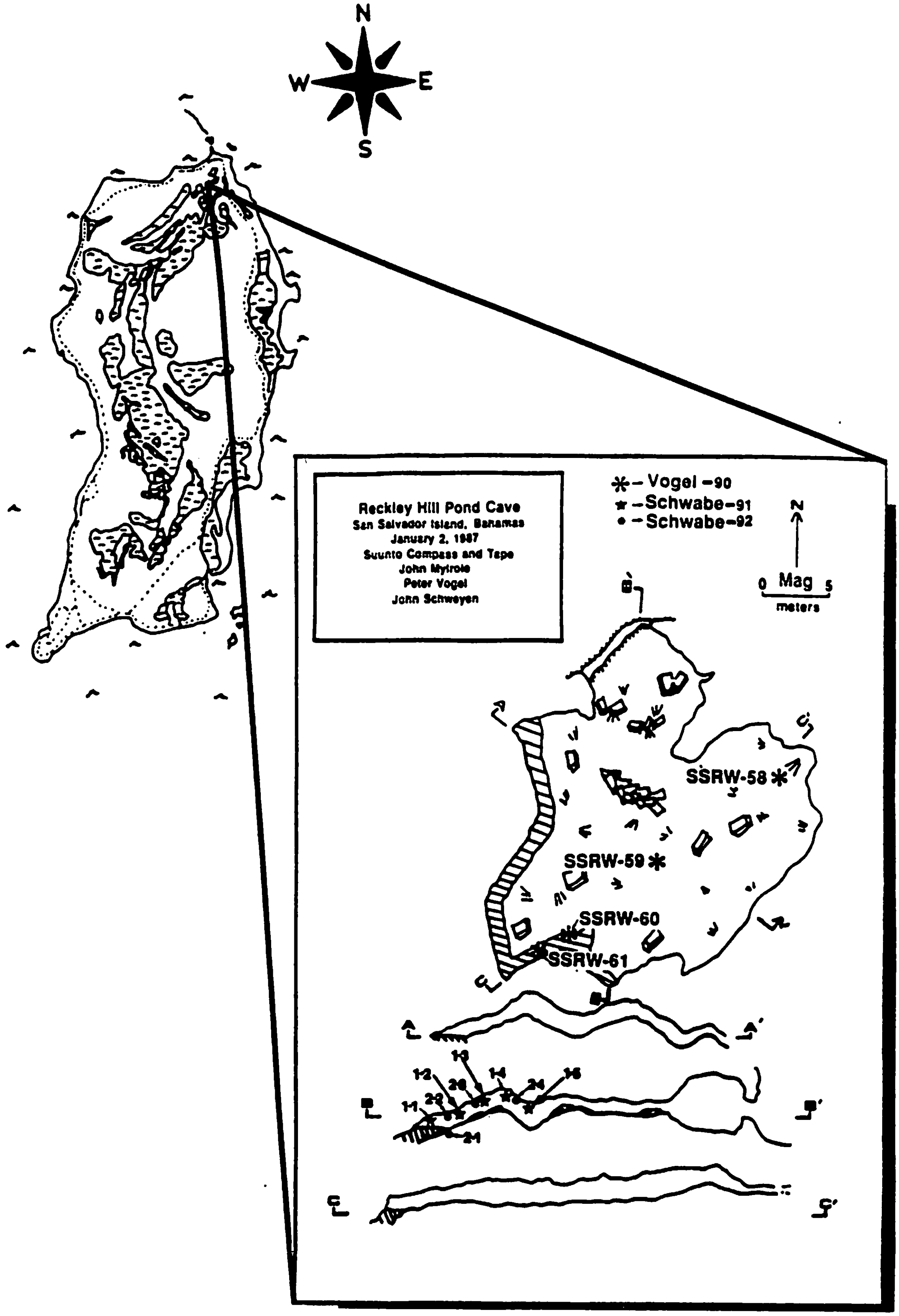

Figure 3. Map of Reckley Hill Pond Cave showing sample localities, and the location of the cave.

	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity			
Ridge samples																			
Sample name/site																	rock name	exact elevation	est. elevation
The Bluff #1	0	0	51	•	0	5	0	0	5	3	•	0	0	40	1	41	Clotted Sparite	0 m / 0 ft	
The Bluff #2	0	0	39	6	0	16	•	7	23	•	0	0	0	33	5	38	Clotted Biosparite	1.1 m / 3.6 ft	
The Bluff #3	0	0	39	11	0	4	0	0	15	•	0	0	0	46	•	46	Clotted Biosparite	2.5 m / 8.2 ft	
The Bluff #4	0	0	50	1	0	3	0	1	5	•	0	0	0	43	2	45	Clotted Biosparite	3.9 m / 12.8 ft	
Crab Cay #1	0	4	60	•	0	3	0	2	5	5	0	0	0	26	0	26	Clotted Pelsparudite	1.0 m / 3.3 ft	
Crab Cay #2	0	7	43	1	0	2	0	3	6	6	2	0	0	31	0	31	Clotted Pelsparudite	1.5 m / 4.9 ft	
Crab Cay #3	0	0	35	2	0	12	•	1	15	8	4	0	0	38	0	38	Clotted Biosparudite	2.5 m / 8.2 ft	
Crab Cay #4	0	5	55	0	0	2	0	2	4	5	2	•	0	28	0	28	Clotted Sparudite	2.9 m / 9.5 ft	
Crab Cay #5	0	14	38	8	0	0	0	0	8	5	1	0	0	34	0	34	Clotted Sparudite	3.1 m / 10.2 ft	
Dixon Hill #1	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		0 m/0 ft
Dixon Hill #2	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		1.2m/3.9ft
Dixon Hill #3	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		2.4m/7.8ft
Dixon Hill #4	•	•	0	•	0	•	0	0	0	0	100	0	0	•	0	•	Pelmicrite		3.2m/10.4ft
Dixon Hill #5	•	•	0	•	0	•	0	0		0	100	0	0	•	0	•	Pelmicrite		4.2m/13.7ft
Dixon Hill #6	•	•	0	•	0	•	0	0	0	0	100	0	0	•	0	•	Pelmicrite		5.3m/17.3ft
Dixon Hill #7	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		6.4m/20.9ft
Dixon Hill #8	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		7.0m/22.9ft
Dixon Hill #9	0	•	0	0	0	0	0	0	0	•	100	0	0	•	0	•	Pelmicrite		7.5m/24.6ft
Dixon Hill #10	0	•	0	0	0	0	0	0	•	•	100	0	0	•	0	•	Pelmicrite		8.8m/28.8ft
Dixon Hill #11	0	•	0	0	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		10.5m/34.4ft
Dixon Hill #12	0	•	0	•	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		11.9m/39.0ft
Dixon Hill #13	0	•	0	•	0	•	0	•	•	•	100	0	0	•	0	•	Biomicrite		13.0m/42.6ft
Dixon Hill #14	0	•	0	•	0	•	•	0	•	•	100	0	0	•	0	•	Biomicrite		13.9/45.6ft
Dixon Hill #15	0	•	0	•	0	•	•	0	•	•	100	0	0	•	0	•	Biomicrite		14.6m/47.9ft
Dixon Hill #16	0	•	0	•	0	•	•	0	•	•	100	0	0	•	0	•	Biomicrite		15.6m/51.1ft
Dixon Hill #17	0	0	•	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		16.6m/54.4ft
Dixon Hill #18	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Pelmicrite		17.6m/57.7ft
Dixon Hill #19	0	•	0	0	0	•	0	0	•	0	100	0	0	•	0	•	Pelmicrite		18.2m/59.7ft
Dixon Hill #20	0	•	0	0	0	•	0	0	•	0	100	0	0	•	0	•	Pelmicrite		19.4m/63.6ft
Dixon Hill #21	•	9	0	1	0	1	0	0	2	3	85	0	0	•	0	•	Pelmicrite		20.6m/67.5ft
Dixon Hill #22	0	•	0	•	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		21.7m/71.1ft
Dixon Hill #23	0	•	0	•	0	•	0	0	•	•	100		0	•	•	•	Biopelmicrite		22.7m/74.4ft
Dixon Hill #24	•	•	0	•	0	•	•	0	•	•	100	0	0	•	•	•	Biopelmicrite		23.8m/78.0ft
Dixon Hill #25	0	•	0	•	0	•	0	0	•	•	100	0	0	•	•	•	Biopelmicrite		24.7m/81.0ft
Dixon Hill #26	0	•	0	•	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		25.8m/84.6ft
Dixon Hill #27	0	•	0	0	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		26.9m/88.2ft
Dixon Hill #28	•	•	0	0	0	•	0	0	•	•	100	0	0	•	0	•	Pelmicrite		28.2m/92.5ft
Dixon Hill #29	18	4	0	0	0	0	0	0	0	13	60	0	0	4	0	4	Oomicrite		29.5m/96.7ft
Dixon Hill #30	30	24	0	0	0	1	0	0	1	21	16	0	0	7	•	7	Oosparite		30.0m/98.4ft

Table 2a Point count data (%) of ridge samples from San Salvador Island.

samples is interpreted as evidence of marine influence in the diagenetic environment in which the caves formed. This is viewed as corroborative of the flank margin model of mixed-water dissolution for cave formation (Mylroie and Carew, 1990). No cave wall rock samples contain aragonite cements.

Ridge Samples

Like the cave samples, the allochem composition of the 198 ridge samples from Great Inagua, Long, New Providence, San Salvador, and South Andros islands can be classified into three general categories: oölitic, non-oölitic, and orthochems (Tables 2, 3, 4). Examination of these samples revealed four common ridge types: peloidal-bioclastic, oölitic, peloidal-bioclastic transitional upward to oölitic, and peloidal-bioclastic unconformably overlain by oölitic deposits. Information about specific ridges is outlined below.

San Salvador Ridges

Petrologic analyses of thirty samples collected along a transect on the west-facing side of Dixon Hill indicate that the ridge is peloidal-bioclastic from the base almost to the top. The last few samples at the top are a mixture of oöids and peloids (Figure 4). In contrast, samples taken from the east-facing slope have been reported to be oölitic (Hutto and Carew, 1984; Carew and Mylroie, 1985). The wall rock of Lighthouse Cave, located within Dixon Hill, has a peloidal-bioclastic composition similar to the samples collected from the lower portion of the measured

Table 2b

	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity			
Ridge samples																			
Sample name/site																	rock name .	exact elevation	est. elevation
The Gulf #1	2	37	0	0	0	0	0	0	0	20	20	0	0	11	11	22	Pelmicrite	0 m / 0 ft	
The Gulf #2	10	67	0	0	0	0	0	•	•	1	•	0	0	11	10	21	Biopelmicrite	1.0 m / 3.3 ft	
The Gulf #3	9	57	0	0	1	0	1	0	2	4	•	0	0	20	8	28	Pelsparite	2.9 m / 9.5 ft	
The Gulf #4	1	29	0	10	4	6	3	10	19	2	•	5	0	25	5	30	Biopelsparite	3.9 m / 12.8 ft	
The Gulf #5	•	66	0	0	0	0	0	1	0	•	0	0	0	20	13	33	Pelsparite	5.7 m / 18.7 ft	
The Gulf #6	1	64	0	•	0	0		4	0	2	0	1	0	20	8	28	Pelsparite	6.7 m / 21.9 ft	
Left Breast Point #1	0	52	0	10	0	0	0	0	10	5	0	0	0	29	1	30	Pelsparite		1.7 m / 5 6 ft
Left Breast Point #2	0	33	0	2	0	0	0	0	2	1	1	0	0	37	0	37	Poorly Washed Pelsparite		1.75 m / 5 7 ft
Observation Tower 591-1	54	7	0	0	•	0	0	0	0	24	0	0		14	1	15	Oosparite		14 0m/45 9ft
Observation Tower 591-2	49	23	0	0	0	0	0	0	0	16	1	0	0	9	2	11	Oosparite		15.0m/49 2ft
Observation Tower 591-3	43	29	0	0	0	0	0	0	0	18	0	0	0	10	0	10	Oosparite		16 0m/52 4ft
Observation Tower 591-4	33	26	0	8	0	0	0	0	8	14	2	0	0	15	2	17	Oopelsparite		17 0m/55 7ft
Observation Tower 591-5	49	19	0	0	0	0	0	0	0	11	0		0	21	0	21	Oosparite		18 0m/59 0ft
Observation Tower 591-6	54	10	0	8	0	0	0	0	8	12	0	0	0	10	8	18	Oosparite		19 0m/62.3ft
Observation Tower 591-7	44	24	0	1	0	0	0	0	1	7	0	0	0	24	0	24	Oopelsparite		20.0m/65 6ft
Observation Tower 591-8	6	7	0	•	0	0	0	0	•	•	78	0	0	8	1	9	Pelmicrite		21.0m/68 8ft
Observation Tower 1291-1	17	37	0	0	0	0	0	0	0	30	0	0	0	4	12	16	Pelsparudite		.87 m / 2.9 ft
Observation Tower 1291-2	22	24	0	2	1	0	0	0	2	37	0	0	0	12	2	14	Peloosparudite		1.6 m / 5.3 ft
Observation Tower 1291-3	5	52	0	0	0	0	0	0	0	36	0	0	0	6	1	7	Pelsparudite		2.2 m / 7.3 ft
Observation Tower 1291-4	1	62	0	•	2	0	0	0	•	17	14	0	0	3	1	4	Poorly Washed Pelsparudite		3.8 m / 12.1 ft
Observation Tower 1291-5	23	35	0	0	0	0	0	0	0	36	5	0	0	1	0	1	Poorly Washed Peloosparudite		4 8 m / 15 7 ft
Observation Tower 1291-6	26	11	0	0	0	0	0	0	0	11	41	0	0	8	3	11	Oopelmicrudite		6 2 m / 20 3 ft
Observation Tower 1291-7	25	24	0	1	0	0	0	0	1	46	1	0	0	2	1	3	Poorly Washed Oopelsparudite		7.5 m / 24 7 ft
Observation Tower 1291-8	32	16	0	0	0	0	0	0	0	34	•	0	0	6	10	16	Poorly Washed Oopelsparudite		8.7 m / 28 7 ft
Observation Tower 1291-9	26	24	0	0	0	0	0	0	0	24	2	0	0	19	5	14	Poorly Washed Oopelsparudite		9 7m/31 8ft
Observation Tower 1291-10	24	34	0	0	0	0	0	0	0	21	15	0	0	2	4	6	Poorly Washed Peloosparudite		10 1 m / 33 3 ft
Observation Tower 1291-11	13	19	0	0	0	0	0	0	0	32	12	0	0	11	13	24	Poorly Washed Peloosparudite		11.6 m / 38 3 ft
Observation Tower 1291-12	44	16	0	0	0	0	0	0	0	30	0	0	0	6	2	8	Oopelsparudite		13.2 m 43 5 ft
Observation Tower 1291-13	26	32	0	0	0	0	0	0	0	38	4	0	0	2	0	2	Poorly Washed Peloosparudite		13.9 m / 46 4 ft
Observation Tower 1291-14	29	32	0	0	0	0	0	0	0	26	3	0	0	9	1	10	Poorly Washed Peloosparudite		15 5 m / 51 0 ft
Reckley Hill #1	42	23	0	0	0	0	0	0	0	27	4	0	0	3	1	4	Oopelsparudite		1.2m/3 9ft
Reckley Hill #2	0	0	0	0	0	0	0	0	0	0	0	89	0	11	0	11	Micrite		1 7m/5 6ft
Reckley Hill #3	45	14	0	0	0	0	0	0	0	33	1		0	6	1	7	Oopelsparudite		2.3m/7 5ft
Reckley Hill #4	0	0	0	4	0	5	0	0	9	0	80	0	0	6	5	11	Biomicrite		3.1m/10 2ft
Reckley Hill #5	0	0	0	0	0	0	0	0	0	•	79	0	0	21	0	21	Micrite		4.2m/13 8ft
Reckley Hill #6	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite		5.9m/19.4ft
Reckley Hill #7	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite		7.4m/24 3ft
Reckley Hill #8	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite		9.2m/30 2ft
Reckley Hill #9	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite		10 5m/34.4ft

	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity			
Ridge samples																			
Samples name/site																	rock name	exact elevation	est. elevation
South Granny Lake Ridge #1-1	31	32	0	0	0	0	0	0	0	26	0	0	0	11	0	11	Peloosparite		1.0m/3 3ft
South Granny Lake Ridge #1-2	44	17	0	•	0	0	0	0		25	0	0	0	14	0	14	Oopelsparite		2 8m/9 2ft
South Granny Lake Ridge #1-3	31	22	0	3	0	0	0	0	3	18	6	0	0	20	0	20	Oopelsparite		3 8m/12 5ft
South Granny Lake Ridge #1-4	42	33	0	0	0	0	0	0	0	17	0	0	0	8	0	8	Oopelsparite		4.3m/14 1ft
South Granny Lake Ridge #1-5	37	32	0	0	0	0	0	0	0	28	1	0	0	2	0	2	Oopelsparite		5.8m/19 0ft
South Granny Lake Ridge #1-6	50	8	0	0	0	0	0	0	0	31	0	0	0	5	0	5	Oopelsparite		6.5m/21 3ft
South Granny Lake Ridge #1-7	47	19	0	0	0	0	0	0	0	15	15	0	0	2	2	4	Oopelsparite		7.4m/24 3ft
South Granny Lake Ridge #1-8	49	16	0	0	0	0	0	0	0	20	15	0	0	0	0	0	Oopelsparite		8 0m/26 2ft
South Granny Lake Ridge #2-1	28	31	0	•	0	0	0	0	0	26	0	•	0	7	8	15	Oopelsparite		1.0m/3 3ft
South Granny Lake Ridge #2-2	0	0	0	2	0	21	•	1	24	4	70	0	0	2	0	2	Biomicrite		1 6m/5 2ft
South Granny Lake Ridge #2-3	0	1	0	0	0	0	0	0	0	23	63	0	0	5	5	10	Pelmicrite		2 5m/8 2ft
South Granny Lake Ridge #2-4	15	48	0	0	0	0	0	0	0	23	0	•	0	5	5	10	Pelsparite		3 9m/12 8ft
South Granny Lake Ridge #2-5	31	12	0	0	0	0	0	0	0	18	38	•	0	1	0	1	Oopelsparite		5 4m/17 7ft
South Granny Lake Ridge #2-6	37	12	0	0	3	3	0	0	3	31	6	0	0	•	•	•	Oopelsparite		6 9m/22 6ft
South Granny Lake Ridge #2-7	54	5	0	0	0	0	0	0	0	12	25	0	0	•	•	•	Oopelsparite		8 4m/27 6ft
South Granny Lake Ridge #2-8	37	13	0	0	1	0	0	0	0	24	24	•	0	•	•	•	Oopelsparite		10 2m/33 5ft
South Granny Lake Ridge #2-9	43	17	0	0	0	0	0	0	0	26	8	0	0	•	•	•	Oopelsparite		12 1m/39 7ft
South Granny Lake Ridge #2-10	18	30	0	0	1	0	0	0	0	32	1	0	0	•	•	•	Peloosparite		15 1m/49 5ft
South Granny Lake Ridge #2-11	54	8	0	0	•	0	0	0	0	23	14	0	0	•	•	•	Poorly Washed Oosparite		17 6m/57 7ft
South Granny Lake Ridge #2-12	0	•	•	•	0	•	•	0	•	20	80	•	0	•	•	•	Biomicrite		20 6m/67 6ft
The Thumb #1-1	0	62	0	2	0	1	0	0	3	12	16	0	0	4	3	7	Pelmicrite	0 m / 0 ft	
The Thumb #1-2	0	68	0	1	0	0	0	0	1	2	3	0	0	15	11	26	Pelmicrite		1 4 m / 4 6 ft
The Thumb #1-3	8	4	0	0	0	0	0	0	0	0	73	0	0	15	0	15	Oopelmicrite		2 0 m / 6 4 ft
The Thumb #1-4	•	39	7	1	0	0	0	0	1	8	17	0	0	28	0	28	Pelmicrite		2 6 m / 8 5 ft
The Thumb #1-5	•	21	1	2	0	0	0	0	2	•	62	0	0	6	8	14	Pelmicrite		3 6 m / 11 8 ft
The Thumb #1-6	0	51	0	0	0	0	0	0	0	35	14	0	0	0	0	0	Poorly Washed Pelsparite		4 2 m / 13 8 ft
The Thumb #1-7	•	50	7	3	0	0	0	0	3	17	5	0	0	17	1	18	Poorly Washed Pelsparite		4 3 m /14 7 ft
The Thumb #2-A	•	30	27	•	3	1	0	0	1	1	33	0	0	1	4	5	Clotted Pelmicrite	4 0 m /13.1 ft	
The Thumb #2-B	•	57	•	1	0	•	0	0	1	5	•	0	0	37	0	37	Pelsparite	4 0 m /13.1 ft	
The Thumb #2-C	1	58	0	2	0	•	0	0	2	21	5	0	0	11	4	15	Pelsparite	4 0 m/ 13.1 ft	

Table 2c Point count data (%) of ridge samples from San Salvador Island.

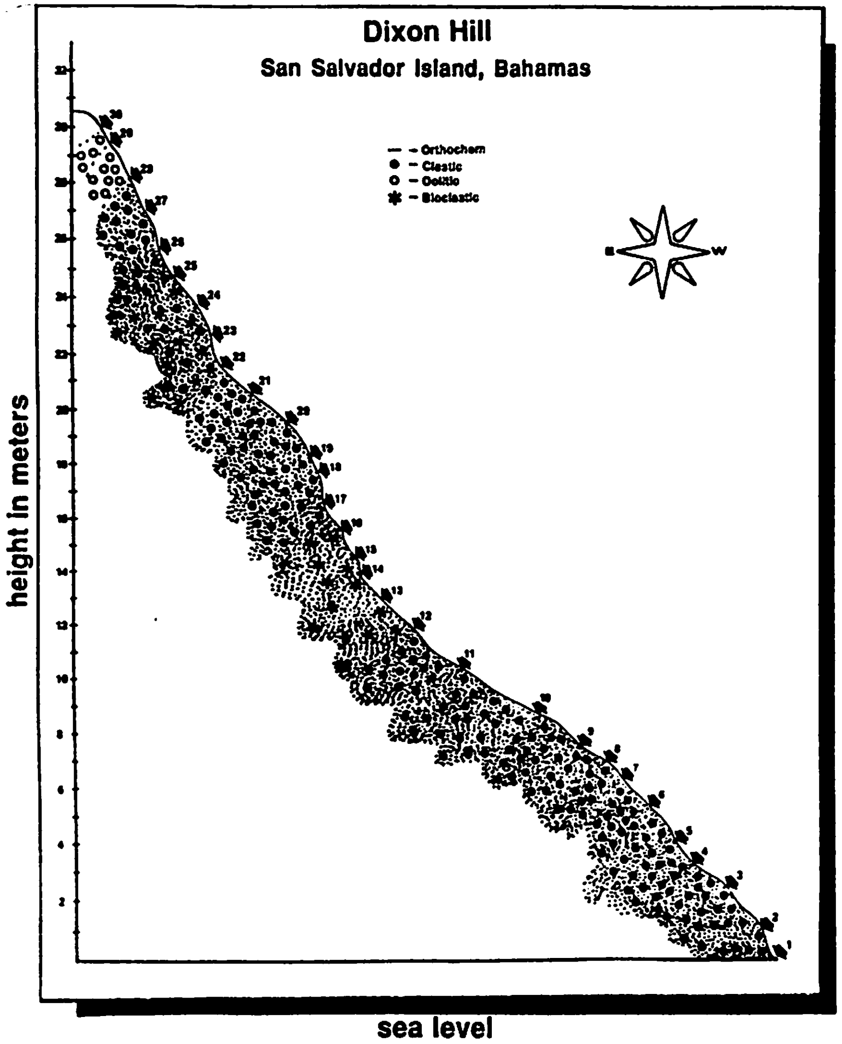

Figure 4. Diagrammatic representation of the measured section on the west-facing slope of Dixon Hill showing sample locations and rock type.

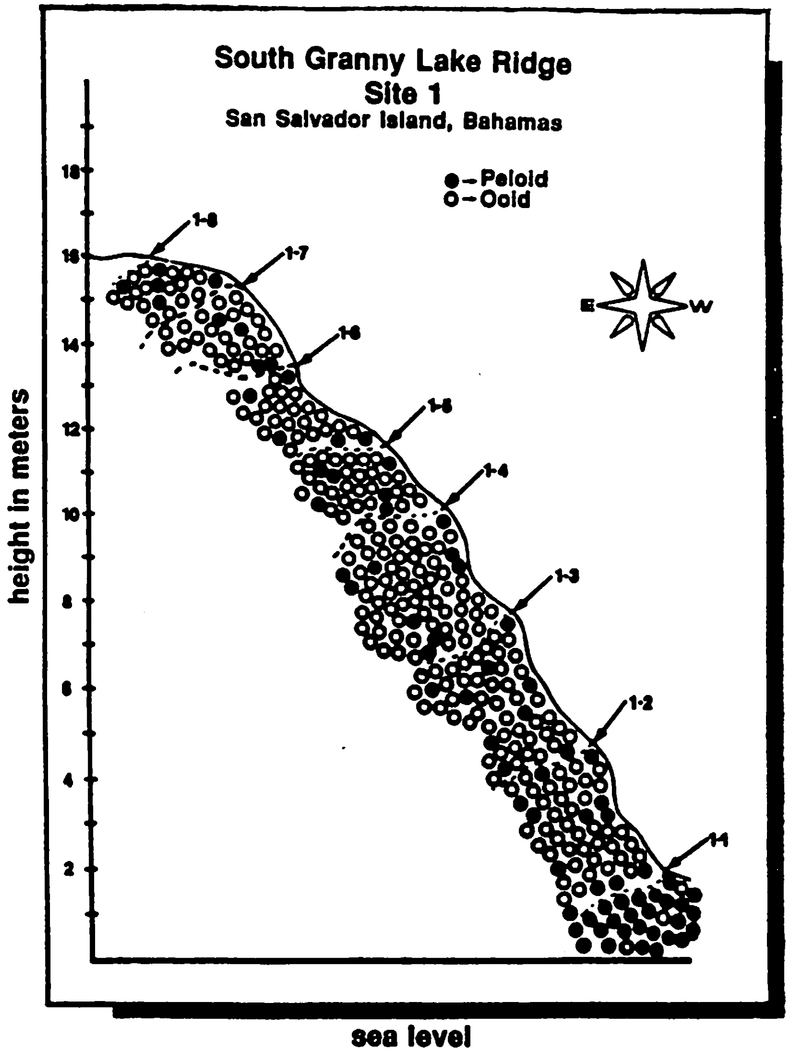

Figure 5. Diagrammatic representation of the measured section on the west-facing slope of South Granny Lake ridge showing sample locations and rock

section on the west side (Table 1a).

Samples collected from ridges along the east coast of San Salvador, such as Crab Cay, The Thumb, Left Breast Point, and The Bluff are primarily peloidal, and nearly all contain no oöids (Table 2).

Ridges located in the interior of the island exhibit a variety of composition patterns. The west-facing slope of South Granny Lake ridge (Figure 5) is a mix of peloids and oöids at the base and becomes more oölitic toward the top, whereas the east-facing slope (Figure 6) is oölitic at the base overlain by about two meters of peloidal-bioclastic deposits that grade up into dominantly oölitic sands. Observation Tower ridge, located to the west of South Granny Lake, has an east-facing slope that is largely a mix of oöids and peloids, with peloids dominant, from lake level up to about +5 meters. From about +6 meters upward to just below the ridge crest, oöids are more abundant than peloids. Near the top the samples are dominantly oölitic (Figure 7). On-the-other-hand, the west-facing side of the ridge, from the parking lot level upward to the top, is dominantly oölitic.

Samples taken along a transect up the west-facing side of Reckley Hill have been largely diagenetically altered to micrite (Figure 8). Those few allochems that can be identified are oöids and peloids. Samples taken along a measured section at The Gulf are largely peloidal, with oöids as a significant fraction from about one to three meters above sea level.

Ridge samples are cemented by fresh-water vadose or phreatic spar cements, or by micrite that is probably of diagenetic origin. No ridge samples from San Salvador contain aragonite cement.

Ridges on other islands

Samples taken from eolian ridges on South Andros Island are largely oölitic, or are composed of a mixture of oöids and peloids (Table 3). Non-oöid bearing eolianites are unknown on South Andros. Most of the eolianites are cemented by equant spar cements, with a lesser number of micrite cemented samples. No samples are cemented by aragonite (Table 3). Lack of detailed sampling along transects of course precludes our ability to determine whether there are any vertical or lateral composition changes similar to those seen on San Salvador Island.

Samples from eolianites on Long, Great Inagua, and New Providence islands (Table 4) show compositions and cementation styles similar to those seen elsewhere, but their usefulness in fully documenting the development of eolianite ridges there suffers, as we now know, from lack of coordination to measured sections. Samples from New Providence exhibit a particularly diverse suite of allochem compositions and diagenetic conditions; and it is only on that island that we have encountered oölitic eolianites overlain unconformably by another oölitc eolianite. No aragonite cements have been seen in any of the samples.

DISCUSSION AND CONCLUSIONS

We can recognize four types of Pleistocene eolianite ridges, those that are oölitic throughout, those that are peloidal-bioclastic throughout, and those that are peloidal-bioclastic low and either grade upward into oöid-dominated deposits or are unconformably overlain by oölitic eolianite. On San Salvador, large volume production of oölitic eolianites seems to be restricted to the highstand of sea level during substage 5e.

The fact that nearly all horizontal dissolution caves are developed in peloidal-bioclastic eolianites, while nearly all vertical pit caves penetrate only oöid-dominated eolianites (Pace, and others, this volume) suggests that the oöid-dominated eolianites that were deposited during the highstand of sea-level associated with oxygen isotope substage 5e, buried underlying peloidal-bioclastic eolian deposits that had formed during earlier highstands of sea level. Considering the isostatic subsidence of the Bahamas and the published information on late Pleistocene sea-level highstand elevations and times, the underlying peloidal-bioclastic eolianites were probably deposited during the highstands of sea level associated with oxygen isotope stages 7 and/or 9.

In some places peloidal-bioclastic eolianites can be seen to be unconformably overlain by oölitic eolianites (e.g. Watling's Quarry and Owl's Hole on San Salvador Island, Carew and Mylroie, 1985, and Stowers and others, 1989; Bahamas West Cave on New Providence Island, Mylroie and others, 1991, and Carew and others, 1992). The unconformity at those locations is marked by a paleosol. At all other localities, no demonstrable unconformity can be recognized. This may be because: (1) the paleosol between the eolianites is only exposed if dissolution of a cave penetrated far enough upward to intersect the paleosol, or vertical dissolution features extended far enough

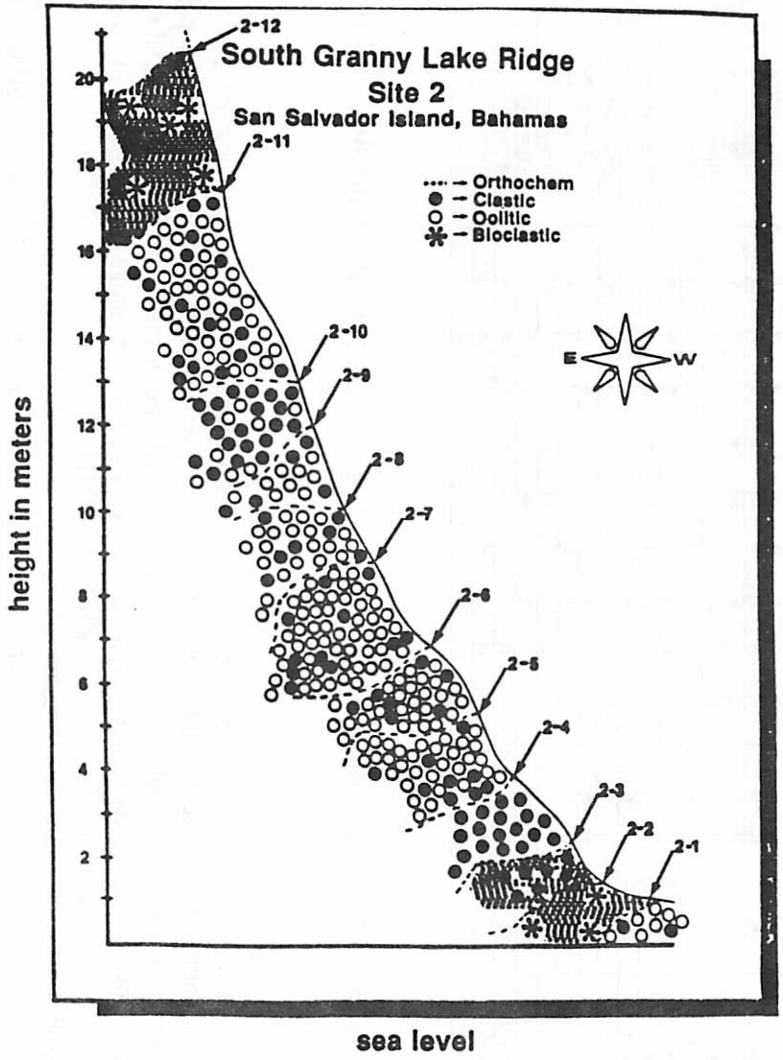

Figure 6. Diagrammatic representation of the measured section on the east-facing slope of South Granny Lake ridge showing sample locations and rock type.

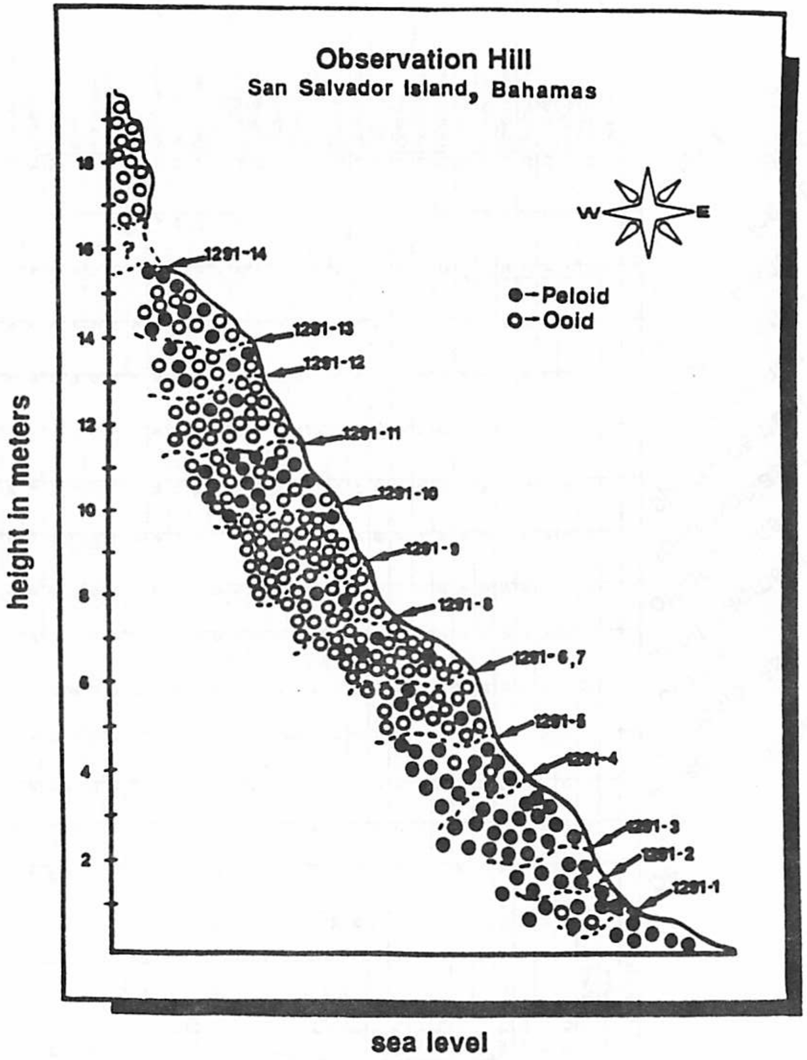

Figure 7. Diagrammatic representation of the measured section on the east-facing slope of Observation Tower ridge showing sample locations and rock type.

	oölith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity	
Ridge samples																	
Sample name																	rock name
Andros Island	49	14	0	0	0	0	0	0	0	26	0	0	0	11	0	11	Oosparite
An 87-1	58	2	0	0	0	0	0	0	0	26	0	0	0	13	0	13	Oosparudite
An 87-2	50	5	0	0	0	0	0	0	0	33	0	0	0	11	0	11	Oosparite
An 87-3	32	0	0	0	0	0	0	0	0	46	0	0	0	13	9	22	Oosparudite
An 87-4	55	4	0	0	1	1	0	0	1	26	0	0	0	12	1	13	Oosparudite
An 87-5	52	0	0	0	0	0	0	0	0	30	0	0	0	15	0	15	Oosparudite
An 87-6	44	0	0	0	0	0	0	0	0	29	0	0	0	23	4	27	Oosparite
An 87-7	58	1	0	0	0	0	0	0	0	30	0	0	0	10	1	11	Oosparudite
An 87-8	49	0	0	0	0	0	0	0	0	47	0	0	0	1	3	4	Oosparudite
An 87-9	35	0	0	0	0	4	0	0	4	54	0	0	0	3	4	7	Oosparite
An 87-10	51	0	0	0	0	0	0	0	0	30	0	0	0	5	14	19	Oosparite
An 87-11	36	16	0	0	0	0	0	0	0	44	0	0	0	0	2	2	Oosparudite
An 87-12	30	25	0	0	4	•	•	0	•	36	0	0	0	4	1	5	Oopelsparudite
An 87-13	7	7	0	0	0	4	0	0	4	5	76	0	0	1	0	1	Oopelmicrite
An 87-14	51	2	0	0	3	0	0	0	0	34	0	0	0	5	5	10	Oosparudite
An 87-15	48	0	0	0	0	0	0	0	0	39	0	0	0	4	9	13	Oosparudite
An 87-16-1	40	4	0	0	1	0	2	0	2	40	0	0	0	10	3	13	Oosparudite
An 87-16-2	48	0	0	0	0	0	0	0	0	37	0	0	0	15	0	15	Oosparudite
An 87-16-3	55	0	0	0	0	0	0	0	0	43	0	0	0	1	1	2	Oosparudite
An 87-17	33	0	0	0	0	0	0	1	1	34	0	0	0	4	27	31	Oosparudite
An 87-18	52	0	0	0	0	0	0	0	0	31	0	0	0	3	14	17	Oosparudite
An 87-19	41	14	0	0	0	0	0	0	0	29	3	0	0	8	5	13	Poorly Washed Oosparudite
An 87-20	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Micrite
An 87-21	0	•	0	0	0	0	0	0	0	0	100	0	0	•	0	•	Micrite
An 87-22-1	0	0	0	0	0	0	0	100	100	0	0	0	0	0	•	•	Biosparite
An 87-22-2	0	0	0	0	0	0	0	100	100	0	0	0	0	0	•	•	Biosparite
An 87-23	•	46	•	0	0	0	0	0	0	18	13	0	0	23	•	23	Pelsparite
An 87-24	5	24	0	0	0	0	0	0	0	6	45	0	0	19	1	20	Pelmicrite
An 87-25-1	16	27	0	0	0	0	0	0	0	38	0	0	0	3	16	18	Peloosparudite
An 87-25-2	47	13	0	0	0	0	0	0	0	37	0	0	0	2	1	3	Oosparudite
An 87-26	7	26	0	0	0	0	0	0	0	49	0	0	0	10	6	16	Pelsparudite
An 87-27	29	27	0	0	1	0	0	0	0	32	0	0	0	9	2	11	Oosparudite
An 87-28	25	31	0	0	2	0	0	0	0	32	0	0	0	10	0	10	Peloosparudite
An 87-29	15	23	0	0	0	0	0	0	0	41	0	0	0	18	3	21	Peloosparudite
An 87-30	14	33	0	9	0	0	0	0	0	30	0	0	0	14	0	14	Peloosparudite
An 87-31	20	49	0	0	0	0	0	0	0	24	0	0	0	7	0	7	Peloosparudite
An 87-32	23	27	0	0	1	0	0	0	0	32	0	0	0	10	12	22	Peloosparudite
An 87-33	31	43	0	0	1	0	0	0	0	22	0	0	0	3	0	3	Peloosparudite
An 87-34	•	•	0	0	0	0	0	50	0	10	0	0	0	20	20	4	Biosparudite
An 87-35	7	34	0	0	0	0	0	0	0	57	0	0	0	1	1	2	Pelsparite
An 87-35-A	0	6	0	0	0	0	0	0	0	12	75	0	0	7	0	7	Pelmicrite
An 87-36	10	20	0	0	0	0	0	0	0	60	0	0	0	3	7	10	Peloosparudite
An 87-37	14	56	0	0	0	0	0	0	0	26	3	0	0	1	0	1	Peloosparudite
An 87-38	5	65	0	0	0	0	0	0	0	15	•	0	0	15	0	15	Pelsparite
An 87-39	25	23	0	0	0	0	0	0	0	61	0	0	0	11	5	16	Oopelsparudite
An 87-40	30	31	0	0	0	0	0	0	0	36	0	0	0	3	0	3	Peloosparudite
An 87-43	22	35	0	0	0	0	0	0	0	31	0	0	0	12	0	12	Peloosparudite
An 87-44	24	12	0	0	0	0	0	0	0	49	0	0	0	3	12	15	Oosparudite
An 87-45	20	23	0	0	0	0	0	0	0	31	0	0	0	14	12	26	Peloosparite
An 87-46	•	•	0	0	0	0	0	0	0	•	1	0	0	•	•	•	Micrite
An 87-47	•	•	0	0	0	0	0	0	0	•	1	0	0	•	•	•	Micrite

Table 3. Point count data (%) from ridge samples from South Andros Island.

downward to penetrate the paleosol, or roadcuts or quarries cut deep enough to intersect and penetrate the paleosol (Figure 9). (2) The paleosol was removed by erosion before deposition of the overlying unit, as seen at Grotto Beach on San Salvador (Carew and Mylroie, 1985; Stowers and others, 1989). (3) Because of the discontinuous nature of the deposition of these eolianites, some locations may accurately record the depositional events as two separate and recognizable units, and others may have composite paleosols that record the same time interval, but do not permit recognition of those events (Carew and Mylroie, 1991).

While there seems to be a common pattern of peloidal-bioclastic eolianites overlain by oölitic eolianites throughout the Bahamas, allochem composi-

	oolith	peloid	clotted micrite	algae	grapestones	forams	shell fragments	other grains	total bioclasts	sparry cement	micrite cement	whisker cement	arg. cement	interpartical porosity	intrapartical porosity	total porosity	
Long Island																	
LI 90-3	2	27	25	•	0	1	0	0	1	5	1	0	0	39	•	39	Clotted Pelsparudite
LI 90-3A	4	30	18	•	•	4	1	0	5	12	0	0	0	31	•	31	Clotted Pelsparudite
LI 90-4	•	7	28	0	0	6	1	0	7	•	0	0	0	56	2	58	Clotted Pelsparudite
LI 90-5	•	19	38	1	0	11	0	0	12	15	2	0	0	11	3	14	Clotted Pelsparudite
LI 90-6	30	17	5	0	0	1	0	0	1	17	•	0	0	24	6	30	Oopelsparite
LI 90-11	40	20	1	0	0	0	0	0	0	17	0	0	0	21	1	22	Oopelsparite
Great Inagua																	
GI 88-1	33	26	0	0	1	0	0	0	0	30	0	0	0	8	2	10	Oosparite
GI 88-8	0	56	0	1	0	0	0	0	1	4	0	0	0	39	0	39	Pelsparite
GI 88-9	0	23	13	5	0	0	8	0	13	12	13	0	0	26	0	26	Pelmicrite
New Providence Island																	
NP 88-1	1	29	14	2	0	1	1	0	4	9	0	0	0	41	2	43	Clotted Pelsparite
NP 88-2	9	34	6	4	5	1	0	0	5	14	0	0	0	25	0	25	Pelsparite
NP 88-3	27	26	0	0	0	0	0	0	0	16	0	0	0	21	10	22	Oopelsparudite
NP 88-4	15	16	0	0	0	2	0	0	2	2	60	0	0	5	0	5	Oopelmicrite
NP 88-6	16	38	0	2	1	0	0	0	2	26	0	0	0	11	6	17	Peloosparudite
NP 88-7	0	43	8	1	0	•	0	0	1	10	5	0	0	33	0	33	Poorly Washed Pelsparudite
NP 88-8	1	53	0	0	0	0	0	0	0	12	4	0	0	29	1	30	Poorly Washed Pelsparudite
NP 88-9	5	57	0	0	0	0	0	0	0	23	1	0	0	13	1	14	Poorly Washed Pelsparudite
NP 88-11	•	•	0	•	0	•	0	0	•	0	1	0	0	•	•	•	Micrite
NP 88-12	25	17	0	2	0	0	0	0	2	33	0	0	0	14	9	23	Oopelsparudite
NP 88-14	56	1	0	0	0	0	0	0	0	20	0	0	0	23	0	23	Oosparudite
NP 88-15	8	48	4	0	0	0	0	0	3	7	13	0	0	20	0	2	Poorly Washed Pelsparudite
NP 88-17	0	32	22	0	0	3	0	0	3	3	11	0	0	29	0	29	Clotting Pelmicrite
NP 88-19	•	•	0	•	0	•	0	0		0	1	0	0	•	•	•	Micrite
NP 88-20	0	15	0	4	0	27	1	0	32	7	0	0	0	25	1	26	Biosparudite
NP 88-21	0	10	0	6	0	24	1	0	31	28	30	0	0	•	•	•	Poorly Washed Biosparudite
NP 88-22	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite
NP 88-23	0	30	4	4	0	2	0	0	6	6	36	0	0	17	0	17	Pelmicrite
NP 88-24	47	13	0	0	0	0	0	0	0	23	0	0	0	14	3	17	Oopelsparudite
NP 88-25	1	44	1	0	0	3	0	0	3	9	17	0	0	24	1	25	Poorly Washed Pelsparudite
NP 88-27	0	0	0	•	0	•	0	0		0	1	0	0			•	Micrite
NP 88-29	0	14	26	2	0	•	3	0	5	9	0	0	0	36	0	36	Clotted Pelsparudite
NP 88-30	0	0	0	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite
NP 88-31	•	•	•	0	0	0	0	0	0	0	1	0	0	•	0	•	Micrite
NP 88-32	0	36	31	1	0	6	0	0	0	6	0	0	0	19	2	21	Clotted Pelsparite
NP 88-33	0	58	0	0	0	0	0	0	0	0	17	0	0	20	5	25	Pelmicrite
NP 88-34	0	58	0	1	0	0	0	0	1	22	4	0	0	15	0	15	Poorly Washed Pelsparite
NP 88-35	4	40	5	0	0	0	0	0	0	21	2	0	0	28	0	28	Pelsparite
NP 88-36	14	17	3	0	11	3	0	0	3	5	12	0	0	31	4	35	Poorly Washed Peloosparudite
NP 88-37	17	18	3	3	5	2	0	0	5	26	12	0	0	11	3	14	Peloosparudite
NP 8-38	24	38	0	1	0	0	0	0	1	17	0	0	0	19	1	20	Peloosparudite

Table 4. Point count data (%) from ridge samples from Great Inagua, Long, and New Providence islands.

tion cannot be used to assign with certainty either peloidal-bioclastic or oölitic eolianites to a stratigraphic position where no vertical relationship can be demonstrated, such as those at The Bluff, Crab Cay, The Thumb, etc. on San Salvador. In addition, there are localities where peloidal/oölitic eolianites unconformably overlie another eolianite of similar composition (e.g. Collins Avenue roadcut and Hunt's Cave quarry, New Providence). Also, two of the authors (Carew and Mylroie) have observed Holocene (North Point Member) peloidal eolianites, up to 30 meters high, that entomb Pleistocene (Grotto Beach Formation) oölitic eolianites on Long Island in precisely the same fashion suggested here for the Pleistocene deposits. Therefore, use of morphostratigraphy to determine the relative stratigraphic position of eolianites in the Bahamas is bound to yield a flawed understanding. Mantling of one eolianite by another is variable both along a dune's length, and from one dune to another. So, spot sampling and morphologic relationships seen in aerial photographs will not lead to an accurate picture of the relationships between deposits. Only detailed sampling along measured sections combined, where possible, with data obtained from caves developed within ridges will yield satisfactory results.

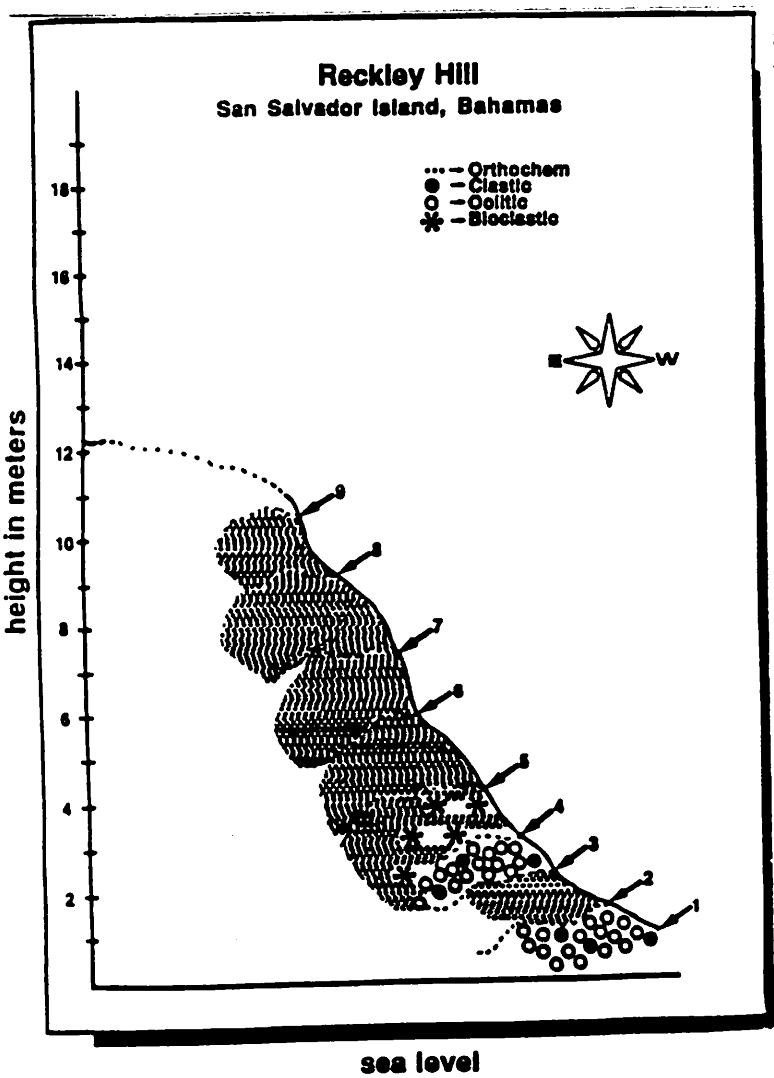

Figure 8. Diagrammatic representation of the measured section on the west-facing slope of Reckley Hill showing sample locations and rock type.

Despite an exhaustive search for a diagenetic signature that would indicate inundation of some of these eolianites by marine water during the peak of the substage 5e highstand, we have been unable to discern any reliable diagenetic indicator of that event. White and White (1991) reported evidence of Holocene marine cementation in both Holocene and Pleistocene eolianites exposed to marine conditions today. However, they found evidence of marine cements in only 57% of their samples, and in many of them it was confined to a few needles in intragranular pores. The failure to find similar evidence of marine cementation from the highstand of substage 5e suggests that a marine signature like that reported by White and White (1991) is surficial and ephemeral.

The cave data indicate that the diagenesis that resulted in the dissolution of such large voids has erased all evidence of previous diagenetic signatures. Among the cave samples there are distinct differences in cementation and porosity dependent on position within the caves. However, those differences are more likely due to the sample proximity to sea level and marine water today. Only the occurrence of small amounts of dolomite in some of the cave samples can be seen as indicative of marine influence in rock diagenesis.

In conclusion, Pleistocene eolianite allochem composition and diagenetic condition cannot be reliably used to determine the correct stratigraphic position for the eolianites in the absence of demonstrable overlapping relationships seen in the field.

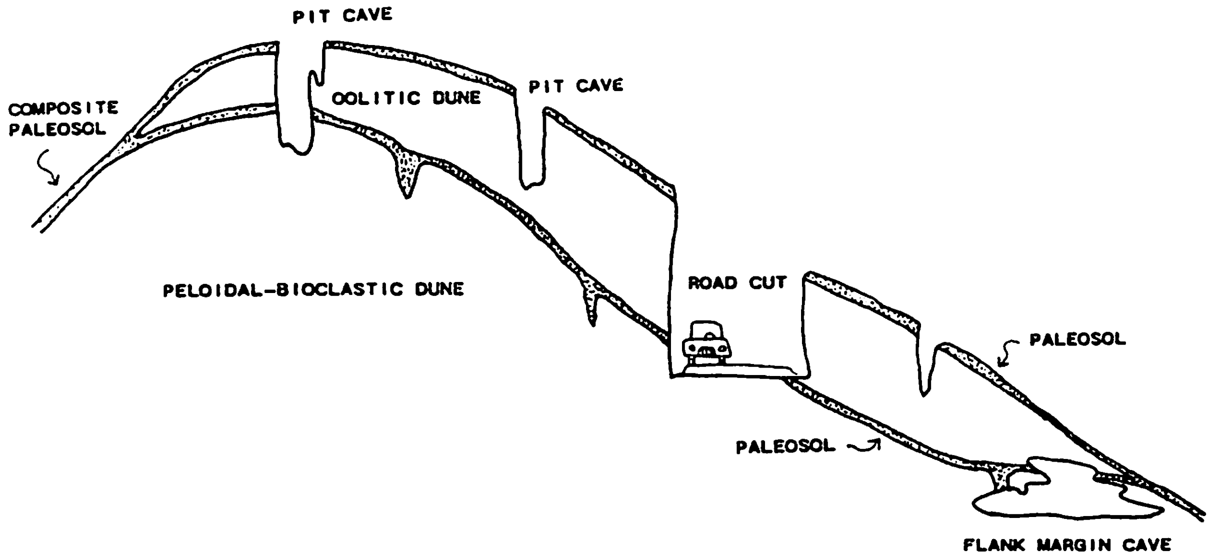

Figure 9. Diagram illustrating relationships between eolianites, paleosols, flank margin caves, pit caves, and man-made rock cuts.

While it appears that the highstand of sea level associated with substage 5e was the time of major oöid deposition in eolianites throughout the Bahamas, both older (Hunt's Cave quarry, New Providence, Table 3) and younger (Joulters Cays) oöid-dominated deposits exist. Further, diagenetic alteration of these Pleistocene deposits, both cementation and secondary porosity, is so variable that diagenetic condition is not a reliable indicator of age or stratigraphic position.

ACKNOWLEDGMENTS

We thank Dr. Donald T. Gerace, Executive Director of the Bahamian Field Station, for financial and logistical support . Special thanks also to Kathy Gerace, Assistant Director, and the staff of the Bahamian Field Station. The Geology Department of the College of Charleston provided the support for thin section production and analyses, and for XRD analyses. Thanks also to Drs. Roger Bain and Brian White for consultation concerning thin section interpretation. Many thanks to Michael Pace for conducting the XRD analyses.

REFERENCES CITED

Bottrell, S. H., Carew, J. L., and Mylroie, J. E., 1992, Inorganic and bacteriogenic origins for sulfate crusts in flank margin caves, San Salvador Island, Bahamas, in White, B., ed., Proceedings of the Sixth Symposium on the Geology of the Bahamas: San Salvador, Bahamas, Bahamian Field Station, Ltd., (in press).

Carew, J. L., and Mylroie, J. E., 1985., The Pleistocene and Holocene stratigraphy of San Salvador Island, Bahamas, with reference to marine and terrestrial lithofacies at French Bay, in Curran, H. A., ed., Pleistocene and Holocene carbonate environments on San Salvador Island, Bahamas - Guidebook for Geological Society of America, Orlando Annual Meeting Field Trip #2: Ft. Lauderdale, Florida. College Center of the Finger Lakes Bahamian Field Station, p. 11-61.

Carew, J. L., and Mylroie, J. E., 1991, Some pitfalls in paleosol interpretation in carbonate sequences: Carbonates and Evaporites, 6 (1): 69-74.

Carew, J. L., Mylroie, J. E. , and Sealey, N. E., 1992, Field guide to sites of geological interest, Western New Providence Island, Bahamas, Field Trip Guidebook, Sixth Symposium on the Geology of the Bahamas: Port Charlotte, Florida, Bahamian Field Station, Ltd., p. 1-23.

Hutto, T., and Carew, J. L., 1984, Petrology of eolian calcarenites, San Salvador Island, Bahamas, in Teeter, J. W., ed., Proceedings of the Second Symposium on the Geology of the Bahamas: Fort Lauderdale, Florida, College Center of the Finger Lakes Bahamian Field Station, p. 197-208.

Moore, C. H., 1989, Carbonate diagenesis and porosity, Developments in Sedimentology 46: Amsterdam, Elsevier, 338p.

Mylroie, J. E., and Carew, J. L., 1990, The flank margin model for dissolution cave development in carbonate platforms: Earth Surface Processes and Landforms, 15: 413-424.

Mylroie, J.E., Carew, J. L., Sealey, N. E., and Mylroie, J. R., 1991, Cave development on New Providence Island and Long Island, Bahamas: Cave Science (Transactions of the British Cave Research Association), 18 (3): 139-151.

Pace, M. C., Mylroie, J. E., and Carew, J. L., 1992, Investigation and review of dissolution features on San Salvador Island, Bahamas, in White, B., ed., Proceedings of the Sixth Symposium on the Geology of the Bahamas: San Salvador, Bahamas, Bahamian Field Station, (in press).

Stowers, R. E., Mylroie, J. E., and Carew, J. L., 1989, Pleistocene stratigraphy and geochronology southwestern San Salvador Island, Bahamas, in Mylroie, J. E., ed., Proceedings of the Fourth Symposium on the Geology of the Bahamas: Port Charlotte, Florida, Bahamian Field Station, p. 323-330.

Vogel, P. N., Mylroie, J. E., and Carew, J. L., 1990, Limestone petrology and cave morphology on San Salvador Island, Bahamas: Cave Science (Transactions of the British Cave Research Association), 17 (1): 19-30.

White, K. S., and White, B., 1991, The effects of Holocene sea-level rise on the diagenesis of Quaternary carbonate eolianites, San Salvador Island, Bahamas, in Bain, R. J., ed., Proceedings of the Fifth Symposium on the Geology of the Bahamas: San Salvador, Bahamas, Bahamian Field Station, p. 235-247.