PROCEEDINGS
OF THE
FIFTH SYMPOSIUM
ON THE
GEOLOGY OF THE BAHAMAS

Edited by

Roger J. Bain

Production Editor

Donald T. Gerace

Bahamian Field Station
San Salvador, Bahamas
1991

Printed in USA by Don Heuer

ISBN 0-935909-37-0

DISTRIBUTION OF PLEISTOCENE LITHOFACIES IN THE INTERIOR OF SAN SALVADOR ISLAND, BAHAMAS, AND POSSIBLE GENETIC MODELS

Roger J. Bain
Department of Geology
University of Akron
Akron, OH 44325-4101

ABSTRACT

Sangamonian deposits in the interior of San Salvador Island consist of three lithofacies: oolite, peloidal-bioclastic, and molluscan bioclastic. Locally an Illinoian paleosol and/or micrite crust separates these deposits from pre-Illinoian peloidal-bioclastic silt and sand. Oolite directly overlies Illinoian paleosol/crust at several interior sites, however along island margins the paleosol/crust may be overlain by oolitic or bioclastic sediment or coral encrustations.

Oolite occurs predominantly in arcuate ridges and ooids vary from well-preserved, laminated aragonitic ooids to heavily micritized structureless spheres. Intermediate to these extremes are ooids which display both well-preserved aragonitic cortices and several zones of borings.

Well-sorted, peloidal-bioclastic sediment dominates low areas between oolitic ridges. Ooids occur associated with peloids and bioclasts at the base of ridges either intermixed within beds or as alternating laminae of ooids or peloids and bioclasts. The elevation of fenestral porosity in basal ridge sediment indicates deposition occurred with sea level near its present position.

Molluscan bioclastic facies occurs in central portions of low areas and consists of large (10 cm) pelecypod shells within a bioclastic matrix. The molluscan bioclastic facies lacks evidence of reworking, whereas the peloidal-bioclastic facies is well sorted and commonly displays low amplitude waveform.

The Sangamonian sea flooded a nearly flat San Salvador bank which possessed several remnant pre-Illinoian hills. Shallow water depths across the bank, as well as these remnant hills, partially restricted circulation leading to the generation of ooids. Wind moved ooids toward the southwest where they were deposited on beaches and blown into dunes covering pre-Illinoian hills. Arcuate oolitic dunes began forming perhaps adjacent to tidal channels and were later reworked by storm events. Low dune ridges formed first in the southwest portion of present-day Great Lake area and later, with a continued sea level rise, large parabolic dune tracts developed. As additional dune tracts formed to the east and sea level continued to rise, deeper water flooded the interdune lows, ooid formation ceased and molluscan bioclastic sediment was deposited. Along island margins reefs contributed more marine bioclasts and dunes are rarely oolitic.

With Wisconsinan drop in sea level, peloidal-bioclastic sediment formed beaches and low dunes adjacent to oolite ridges. This restricted marine bioclastic and molluscan environment may have evolved to isolated lacustrine settings the record for which is probably in deeper portions of present-day lakes.

INTRODUCTION

One of the most striking features of San Salvador Island is the presence of numerous arcuate north-south trending oolite ridges throughout the interior of the island, as well as oolitic/bioclastic ridges which parallel the present-day coast. Equally striking and somewhat unique to San Salvador are the numerous lakes which occupy the inter-ridge basins. Lake depths are as much as 4.2 m (14 ft) and added to ridge elevations 36 m (120 ft) the island's interior relief is approximately 40 m (133 ft).

Adjacent to the ridges are relatively horizontal terraces or benches of varying elevations. Two benches of consistent elevations are fairly common, one occurs at or near present-day sea level which is approximately lake level for Great Lake and the second at approximately 3-4 m (10-13 ft) above sea level. Sediment comprising these benches is a mixture of bioclasts, peloids and ooids. Interior lowlands at or near lake level display a poorly-sorted molluscan facies. Large articulate bivalves, many in growth position, are contained in a bioclastic matrix.

Based on morphology, elevation and composition, ridges have been interpreted as eolian in origin. Some interior ridges display well-preserved parabolic dune shapes. Crossbedding within the ridges indicates wind direction during dune formation was from the east.

Benches and inter-ridge lowlands are believed to represent subaqueous deposition and the presence of horizontal, intertidal, fenestral porosity zones near the surface of most deposits supports this interpretation.

The origin of the dune ridges and the sediment of which they are made has been the subject of debate. Titus (1987) proposed that the ridges formed as sea level was falling from a Sangamonian highstand. As evidence for the formation of ridges during a falling sea level, Titus pointed to the decreasing elevation of ridges from the center of the island eastward. Sediment exposed during this emergent event was reworked and blown into dune ridges. This explanation required a later highstand of sea level (prior to Wisconsinan glaciation) to flood the interior and accumulate bioclastic and molluscan deposits in the interdune lowlands. Titus (1987) referred to this second Sangamonian highstand as Lake Cockburn stage and showed widespread flooding of the San Salvador interior.

Several sea level curves have been published (Pinter and Gardner, 1989; Mesolella et al, 1969; Veeh and Chappell, 1970; Chappell and Veeh, 1978; and Goldhammer et al, 1987) and in general agree with the one shown (Fig.1). Some discrepancies occur between published curves but all agree that sea level was either rising at 120,000 years before present (ybp) or was already high at 140,000 ybp and remained high through 120,000 ybp. Following that highstand, sea level dropped and although fluctuations did occur, none of the curves shows a sea level at or above the present. Carew et al (1984) interpret sea levels above the present at 70,000 and 40,000 ybp however, evidence for these highstands has not been recognized elsewhere. Therefore, if Sangamonian deposits on San Salvador Island were deposited during a sea level highstand, which exceeded present-day sea level, they were deposited during a single event sometime between 140 and 120 thousand years before present.

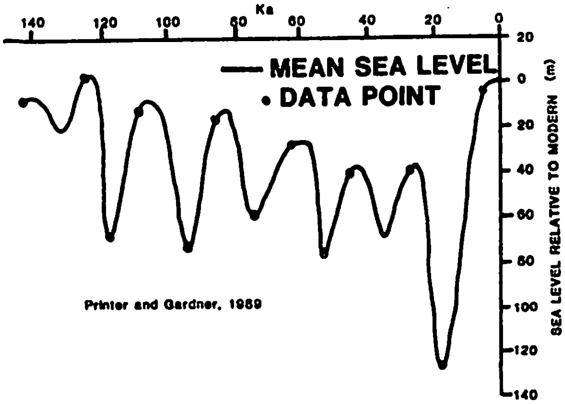


Fig. 1. Sea level curve for period 0 to 140,000 years (ka). Modified from Pinter and Gardner, 1989.

I am proposing that the ooids and oolite ridges in the interior of San Salvador were formed during a rising sea level and that ooid production was halted by continued sea level rise which produced deeper water across San Salvador favoring bioclastic carbonate sedimentation.

OBSERVATIONS

Landforms

Of particular interest to this paper are the deposits and landforms of the interior of San Salvador Island. Landforms can be categorized into five types: 1) arcuate ridges such as those located in the southwestern portion of Great Lake, east and west of Great Lake, west of Granny Lake and several low ridges north of Granny Lake; 2) linear ridges which parallel present-day coastlines such as those separating Stouts Lake from Great Lake to the northwest and Pigeon Creek to the southeast and a low discontinuous ridge which separates the Granny Lake basin from Pigeon Creek basin; 3) flat-topped benches (at lake level and 3-4 m elevation) which occur at the base of most ridges separating the sloping ridge surface from the inter-ridge lakes; 4) interior lowland (generally less than 2 m (6.5 ft) above sea level) such as the extensive areas north and south of Granny Lake and in the northeast portion of Great Lake; and 5) lake basins which are at least 4 m (14 ft) below sea level. Bedrock data from studies by Hutto and Carew (1984), Thalman (1983), Florentino (1985), Florentino and Bain (1984), Sims (1987) and Hebert (1991) as well as this author have been compiled and are presented in Figure

2. A general geomorphic-lithologic relationship for interior arcuate ridges is shown in Figure 3.

Ridges

Interior ridges are dominated by oolitic grainstone. Ooid percentages decrease from near 100% in dune tops to 50% in the basal portions of dunes. Peloids and bioclastic sand occurs mixed with ooids or as laminae interbedded with oolitic laminae. Variations within ooids will be discussed later.

Several exceptions to oolitic ridges exist. The low discontinuous ridge separating Granny Lake from Pigeon Creek which extends southwest from Little Fortune Hill and the larger ridge which separates Stouts Lake from Pigeon Creek are peloidal bioclastic grainstone.

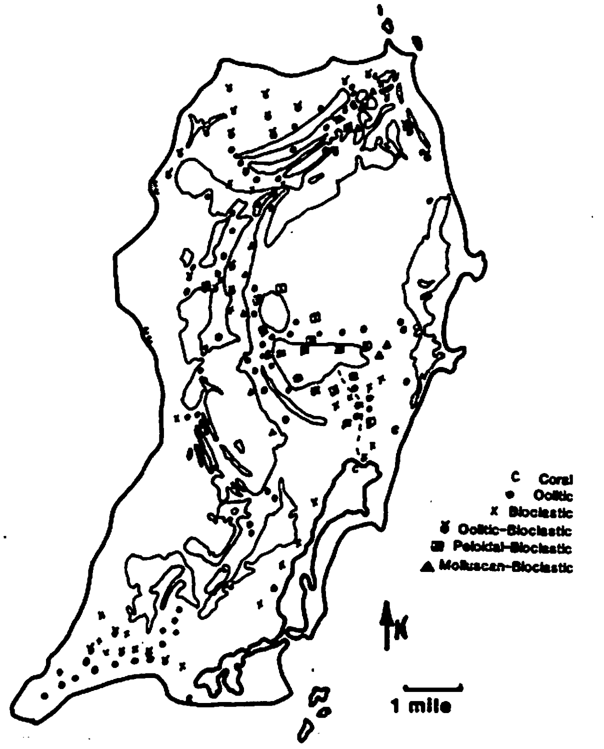


Fig. 2. Sample locations and lithofacies for San Salvador Island.

Benches

Benches both at +3-4 m (10-14 ft) and at lake level consist of a mixture of ooids, peloids and bioclasts. Scattered whole shells and large fragments of molluscs are present at most locations. Texturally the oolitic bioclastic carbonate is a grainstone. Fenestral porosity is present in the upper surface of the lake level bench and has been located as much as 2 m (6.6 ft) above lake level. The sloping surfaces of oolitic dunes generally dive into and under the bench deposits.

Lowland

Extensive lowlands exist on the eastern portion of the interior in the areas north and south of Granny Lake and the northeastern portion of Great Lake. In general, these lowlands are less than 3 m (10 ft) in elevation and have significant karst features. It should be pointed out for later reference that the lowland surface increases in elevation eastward.

Peloidal bioclastic packstone and wackestone comprise the sediment of the interior lowland. Scattered ooids are present but generally are less than 10 percent of the sediment. Locally molluscan fragments and shells are abundant within the carbonate sand. This sediment type extends to lake edge and is the bedrock collected from shallow depths within the lakes. It is believed that the peloidal bioclastic packstone-wackestone extends through the lake basins.

One exception to the dominance of peloidal bioclastic sediment in lowland areas is along the channel which extends discontinuously from Granny Lake to Pigeon Creek. Teeter & Thalman (1984) interpreted this channel as having been a tidal channel during Sangamonian which fed sediment to the tidal delta exposed in Quarry E. Midway between Granny Lake and Pigeon Creek, west of Fortune Hill Settlement (see index map of San Salvador)

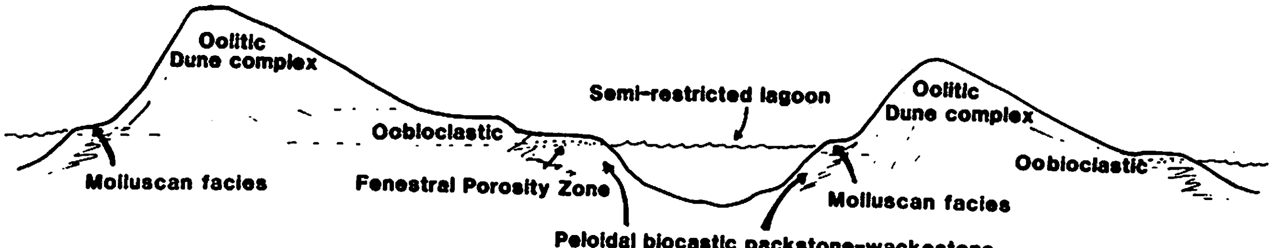


Fig. 3. A generalized geomorphic-lithologic cross section for interior arcuate ridges, inter-ridge basins, benches and lowlands.

a slightly elevated area extends southward from a northeast trending bioclastic ridge. Thalman (1983) collected ooid dominated grainstone from this high on both sides of the channel. Florentino (1985) cored bedrock north of this ridge and noted an increase in ooid percentages adjacent to the channel.

Locally a rich molluscan packstone-wackestone facies exists both on the lowland surface (northeast Great Lake) and on lake level benches (east shore of Great Lake) (Fig.2). In both instances the facies is located on the western side of higher ridges. Mollusc shells measure up to 10 cm in diameter (the fauna and facies has been described by Frances Hagey in this symposium volume).

Since the ridges are composed of ooids predominantly with peloids and bioclasts comprising basal benches and lowland areas the nature and relations of these deposits will be discussed in more detail.

STRATIGRAPHIC RELATIONSHIPS

Figure 2 shows the distribution of data points and illustrates the areal relationship of lithofacies in the interior of San Salvador. In addition to surface samples, stratigraphic sequences are also available in quarries, solution pits and sinkholes and by means of cores. As a result of examination of these sections and cores, lithofacies relationships can be recognized and are illustrated in Figure 4. Of particular interest is the relationship of bioclastic, oolitic, coral, and molluscan facies to each other as well as to paleosols or micritic crusts.

One rather common relationship has oolitic grainstone overlying a paleosol which formed on bioclastic grainstone. This sequence is present at Watlings Quarry, Owls Hole, and Six-Pack Pond. A variation in this relationship is one where mixed oolitic and bioclastic sediment overlies the paleosol which formed on bioclastic grainstone. This second sequence is present at Quarry A, Quarry E and in the Columbus Landings area near Watlings Blue Hole studied by Sims (1987). A third lithofacies relationship consists of a paleosol separating two bioclastic grainstones such as seen at Singer Bar Point and in part at Quarry A and at the Narrows. Quarry A has both mixed oolitic-bioclastic grainstone and bioclastic grainstone-rudstone overlying a micrite crust/paleosol. It appears that the lower areas on the paleosol surface accumulated more bioclastic sediment whereas the paleo-highs accumulated mixed ooids and bioclasts. At the Narrows a 2.5 m (8 ft) core revealed bioclastic grainstone and coral resting upon a paleosol surface which in turn developed on older coral.

Bedrock cores taken in the lowland area south of Granny Lake show a fourth sequence type consisting of peloidal-bioclastic packstone overlying oolitic-peloidal grainstone-packstone. No paleosol was recovered. Coring depths were limited here as elsewhere by the loss of cemented sediment at depth. Generally coring more than 1 m (3 ft) was impossible. Additional cores were taken near the tidal basin along the trail from Little Fortune Hill to Granny Lake. These cores displayed a sequence of mollusc-rich, bioclastic grainstone overlying oolitic grainstone. No paleosol was encountered.

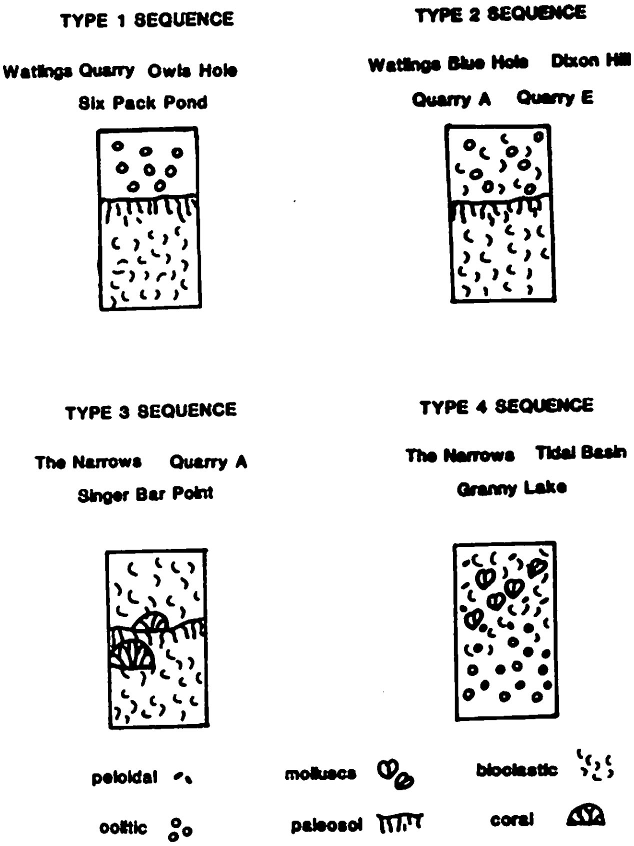


Fig. 4. Types of lithofacies sequences for selected sites on San Salvador Island.

At Dixon Hill, as well as on the hill west of it named Cajun Cay by Hebert (1991), an interpreted sequence consists of bioclastic grainstone capped by a paleosol which is overlain by mixed bioclastic/oolitic sediment. Cajun Cay displays a paleosol surface on bioclastic carbonate and is interpreted as representing the same paleosol seen elsewhere beneath Sangamonian deposits. Dixon Hill stratigraphy is interpreted by correlation to Quarry A, cores taken across Dixon Hill, surface samples and samples collected from within Lighthouse Cave. Lighthouse Cave is in bioclastic material which, it is believed, underlies a paleosol, however the paleosol has not been observed, and I have no proof of its existence in Dixon Hill. The fact that Cajun Cay, as well as an unnamed hill north of Cajun Cay, display paleosol on their surfaces can be explained if another paleo-high in the area of Dixon Hill limited eolian deposition of sediment on them. Coral, occurring as scattered coralites or in reefs, are present on the margins of San Salvador. Many of these coral have been sampled and absolute dates are available (Carew and Mylroie, 987).Their ages range from 150 to 115 thousand years. Also of interest to this discussion is their stratigraphic and topographic positions. As indicated by Curran and White (1984) coral at Cockburn Town reef appear to have grown with sea level at 6 m (20 ft) above present. Their radiometric ages for these corals range from 130 to 119 thousand years (Curran *et al*, 1989). Coral are for the most part encased in bioclastic sediment however some ooids are present. Coral at Grotto Beach within mixed oolite and bioclastic grainstone were dated by Szabo *et al* (1988) and indicated ages of 123 thousand years. These coral indicate a sea level at +3.5 m. Thesestratigraphic relations when correlated seem to indicate a sequence of oolitic grainstone overlying a paleosol. The oolite is overlain in the low interior areas of San Salvador first by mixed oolitic-bioclastic and then by bioclastic grainstone. Along the coasts indications are that environments were dominated by bioclastic deposition and locally coral growth.

OOID VARIATION

Examination of ooids collected from interior and coastal exposures as well as cores indicates several variations in ooid composition and texture. Nuclei of ooids consist of either peloids or bioclastic grains (Fig.5). The internal structure of ooids varies from being unaltered concentric aragonitic laminae to laminae which are bored, infilled by calcite and disrupted. Alternating bands of unaltered aragonite cortices and disrupted, bored calcite-filled zones suggests alteration of the ooids was during ooid growth and not after deposition (Fig.6a). Boring within the altered zones penetrates and disrupts cortices under the bored zones but does not penetrate laminae overlying the bored zone.

Nuclei Variation

Peloid nuclei occur in ooids collected from the western, southwestern and central portions of San Salvador. The ooids are commonly mixed with peloid-rich sediment however ooids dominate. Low percentages of bioclastic material is present and appears to be molluscan fragments.

Eastward and along the coasts ooids possess nuclei of bioclastic grains. Those nuclei which can be identified appear to be fragments

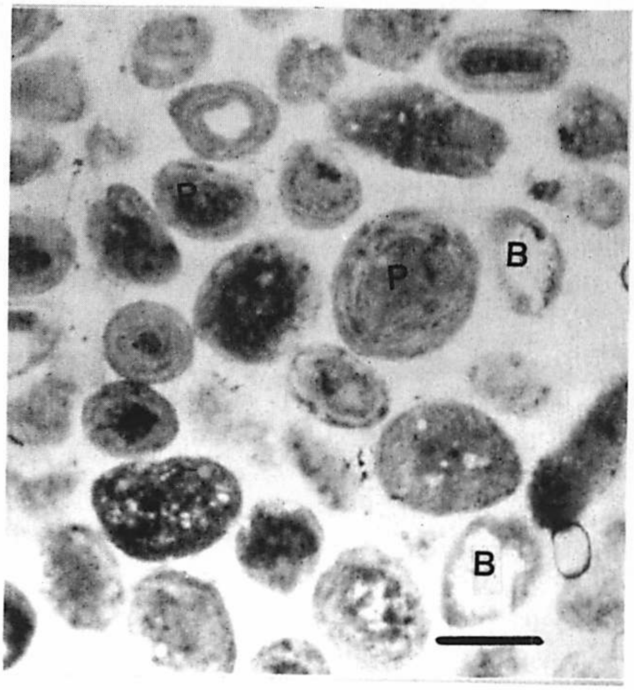
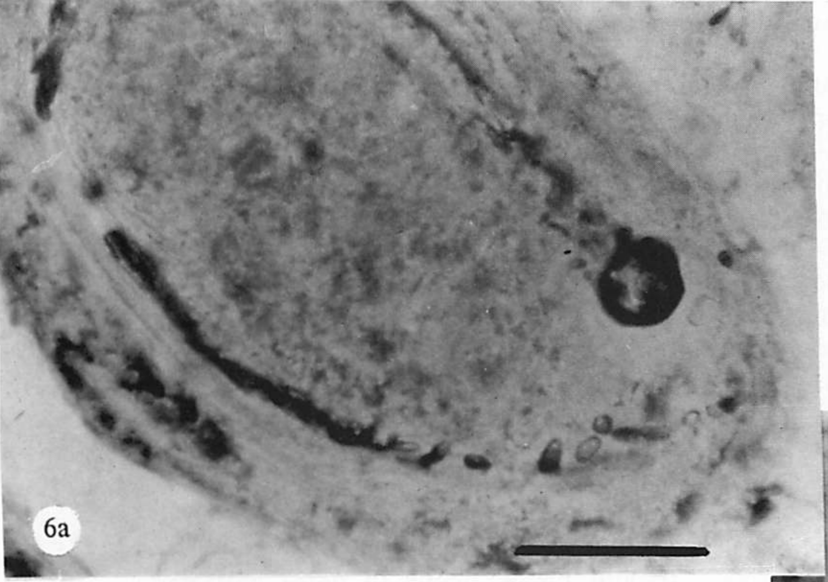
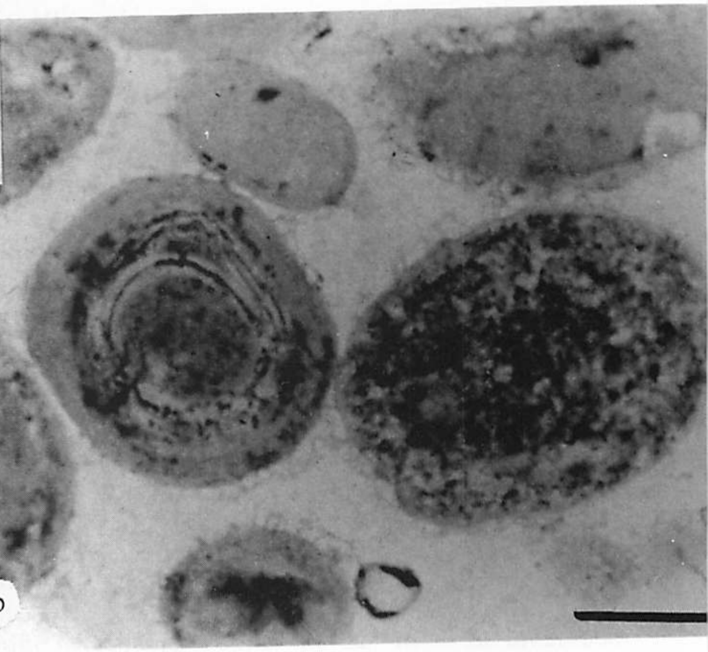
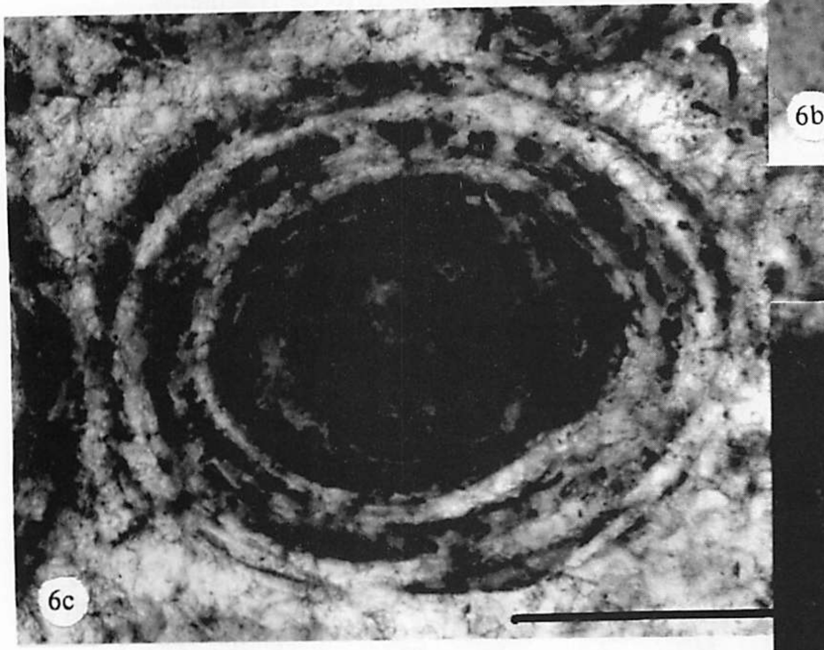


Fig. 5. Photomicrograph of oolitic grainstone. Note ooids possess nuclei of both peloids (P) and bioclasts (B). Scale bar = 0.5 mm.







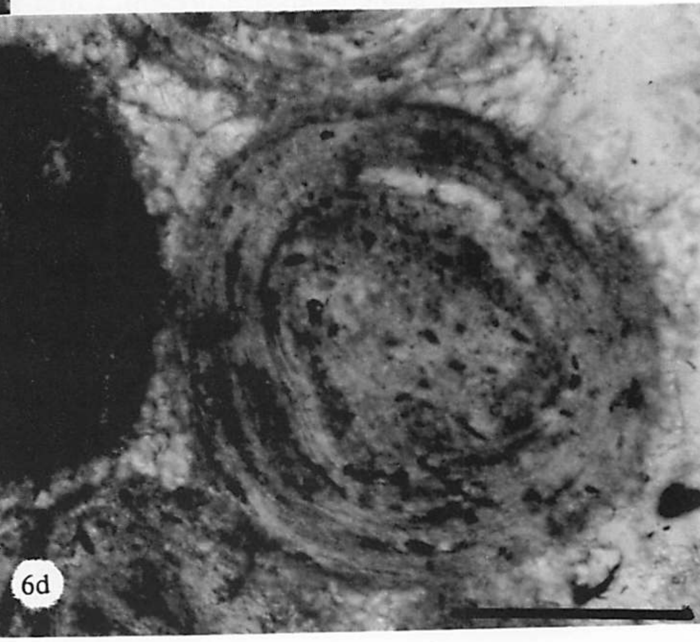


Fig. 6. Photomicrographs of ooids showing varying degrees of alteration by boring and calcite infilling: a) zoned boring affecting underlying laminae; b) total micritization due to boring; c) zoned borings; and d) scattered borings. Scale bar for a = 0.1 mm; b, c and d = 0.25 mm.

of coral, mollusks and red algae. Some nuclei are peloids however the dominance of bioclastic nuclei is noticeable.

Cortices Variation

Degree of boring includes nearly total micritization (Fig.6b), zoned borings (Fig.6c), scattered borings (Fig.6d) and unbored. The distribution of altered ooids is one where intensely bored ooids occur dominantly in the western portion of the interior, especially inland from Halls Landing and in the Columbus Landing area. Ooids from the high ridges adjacent to Granny Lake and eastward display lesser degrees of alteration and east coast ooids (Causeway Quarry and Quarry A) commonly lack significant boring.

INTERPRETATION

Eolian, oolitic dune ridges in the interior of San Salvador formed during the Sangamonian rising sea level. Characteristics of landforms, sedimentary sequences, elevation of deposits and sedimentary structures, distribution of lithofacies as well as previous works support this interpretation. The alternative explanation for the formation of these dune ridges and associated lithofacies offered by Titus (1987) is not supported by any lithologic or geomorphic data.

Dunes are commonly interpreted as having formed during a dropping sea level and I am not arguing with that origin of dunes. As Titus (1987) suggests for San Salvador, as sea level drops previously subaqueously deposited sediment is exposed and can be readily blown into dunes. By dropping sea level an abundant supply of loose sediment becomes available. However, this mechanism is not necessarily required. Progradation can occur without a drop in sea level. All that is needed is high rates of sediment production which exceed the rate of subsidence (or sea level rise). Deltaic environments provide such a setting for siliciclastics and ideal carbonate producing environments such as oolite shoals or reefs certainly can and have produced sediment at rates exceeding subsidence rates. Transgressive dunes have previously been recognized by Carew and Mylroie (1986). The dunes described however were narrow coastal dune complexes.

Nearly all sea level curves published for the last 140,000 years generally agree with the curve published by Pinter and Gardner (1989) (Fig.1). Disagreement does exist regarding the relative positions of sea level fluctuations but nearly all curves agree that there was no highstand of sea level at or above the present sea level position between 120,000 ybp and present. Therefore, lithofacies of Sangamonian age on San Salvador as well as related landforms must be produced during that 130-120,000 time period, although some evidence does support a highstand from 140-120,000 ybp (Goldhammer et al, 1987). Absolute dates available for coral on San Salvador verify that marine, reef-producing conditions existed between 135-118,000 ybp (Curran et al, 1989; Carew and Mylroie, 1987).

Titus (1987) in his regressive dune-forming interpretation cited the eastward decreasing elevation of ridges as evidence for a dropping sea level. What he failed to recognize was that in fact western and southwestern oolite dune ridges are at low elevations; some in southwestern Great Lake are at sea level (lake level) and those east of Halls Landing are at a few meters above sea level. Ridge elevation is at its maximum in the ridge between Great Lake and South Granny Lake. Eastward from this ridge, ridges are lower but vary considerably in elevation. Ridge height does not necessarily relate to sea level position except in that eolian dunes must form above sea level. Ridge height is more related to abundance of sediment and duration of ridge forming processes. As the San Salvador shelf was partitioned by progressively eastward dunes, the sediment producing shelf was reduced. This reduction in source area could explain the lower eastern ridges.

A better indicator of the position of sea level are transitions between eolian and subtidal deposits and sedimentary structures. In examining the elevation of the inter-ridge lowlands, one recognizes that the lowland surface increases in elevation from west to east. This lowland surface in general is composed of subtidal-intertidal sediment. At some locations, fenestral porosity indicative of intertidal conditions has been located. Interestingly, on the shores of Great Lake, fenestral porosity occurs at or slightly below lake level (sea level); in Granny Lake fenestral porosity occurs approximately 1.5 m (4 ft) above lake level; in northwest Great Lake, it is .6 m (2 ft) above lake level and at Causeway Quarry and Quarry A, fenestral porosity is approximately 2 m (7 ft) above sea level. This indicates, if these deposits formed during a single event, that eastern deposits formed under a higher sea level than did western deposits. Likewise, western dunes are submerged either entirely or partially where dune cross bedding extends below or to lake level whereas eastern dunes interbed with intertidal deposits above present-day sea level.

While these deposits indicate sea level above present-day sea level, none of them formed at the +6 m highstand suggested by Curran and White (1984) for Cockburn Town reef. It is suggested that the reef development on the margins of San Salvador was at the maximum highstand and that oolite ridges formed prior to reef development.

Lithofacies distribution, both areal and vertical, support the interpretation that oolite ridges formed during a rising sea level event. Lithofacies consist of oolitic, mixed oolite-peloid-bioclastic, peloid-bioclastic and molluscan bioclastic. Interior ridges from southwest Great Lake to Little Fortune Hill consist of oolitic grainstone. Coastal ridges such as Dixon Hill and Brandy Hill are mixed oolitic-peloidal-bioclastic. Inter-ridge lowlands, both flooded by lakes or exposed, consist of mixed oolitic-peloidal-bioclastic grainstone near ridge bases and peloidal-bioclastic packstone away from ridges. Benches reaching up to 3 m (10 ft) elevation consist of peloid-bioclastic dominated grainstone which locally contain ooids. The molluscan bioclastic packstone is the most restricted of all lithofacies. It occurs in the lowlands in northwest Great Lake, eastern Granny Lake and on the eastern shore of Great Lake.

In vertical sequences oolite overlies the pre-Sangamonian paleosol. It grades upward into a mixed oolitic-peloidal-bioclastic grainstone and/or packstone. Locally the oolitic-peloidal-bioclastic deposit possesses abundant molluscan fauna. It is important to note that no paleosol, micrite crust or any other evidence of exposure exists between the lithofacies.

Sediment becomes more bioclast-dominated upward through lowland sequences and eastward in all deposits. Likewise ooids indicate an eastward bioclastic influence in that nuclei of western ooids are peloids whereas eastern ooids have a higher percentage of bioclastic nuclei.

When the rising Sangamonian sea flooded the San Salvador bank, it covered a heavily karsted paleosol encrusted surface which possessed numerous remnant hills (dunes of Yarmouthian age)(Fig.7a). These remnant hills partially refracted currents moving across the bank and also acted as nuclei for deposition of sediment. Cold water flooding across the San Salvador bank warmed, lost CO_2 and precipitated aragonitic ooids. Initially the shallow water circulation was restricted by the irregularities of the surface causing ooids to be stranded for periods of time resulting in episodic growth of the ooids. This is recorded in the numerous algal bored zones in western ooids. Shallow water conditions restricted the invasion of most forms of shell-secreting organisms perhaps because of temperature and/or salinity fluctuations. Peloids, which occur with ooids either as grains or ooid nuclei, attest to the presence of some life forms. Low oolite ridges formed in southwestern Great Lake area but the remnant hills became the major depocenters explaining the accumulations at Watlings Quarry and the ridge separating Great Lake and Stouts Lake (Fig.7b).

As sea level continued to rise, water depths increased across San Salvador and ooid-producing conditions improved to the point that sediment production exceeded rates of subsidence. Ooids grew more continuously as indicated by the decrease in algal borings. Oolitic sediment moved westward across the San Salvador bank and developed series of arcuate dune ridges perhaps anchored by remnant hills (Fig.7c). As a result of high sedimentation rates an eastward progradation of dune ridges broke the bank into several interdune lagoons. Sea level during this period of transgression was probably at +2 m (7 ft).

At a +3 m (10 ft) sea level, a bioclastic ridge developed south of Granny Lake basin (Fig.7d). As it developed circulation from the present-day Granny Lake basin and the open shelf to the south was restricted. A tidal channel developed, perhaps where the present bedrock channel exists as pointed out by Teeter and Thalman (1984). The tidal channel currents were sufficient to produce ooids locally which accumulated in an ebb tidal delta, the remnants of which are still visible at +3 m (10 ft) elevation.

At maximum highstand of sea level, +6 m

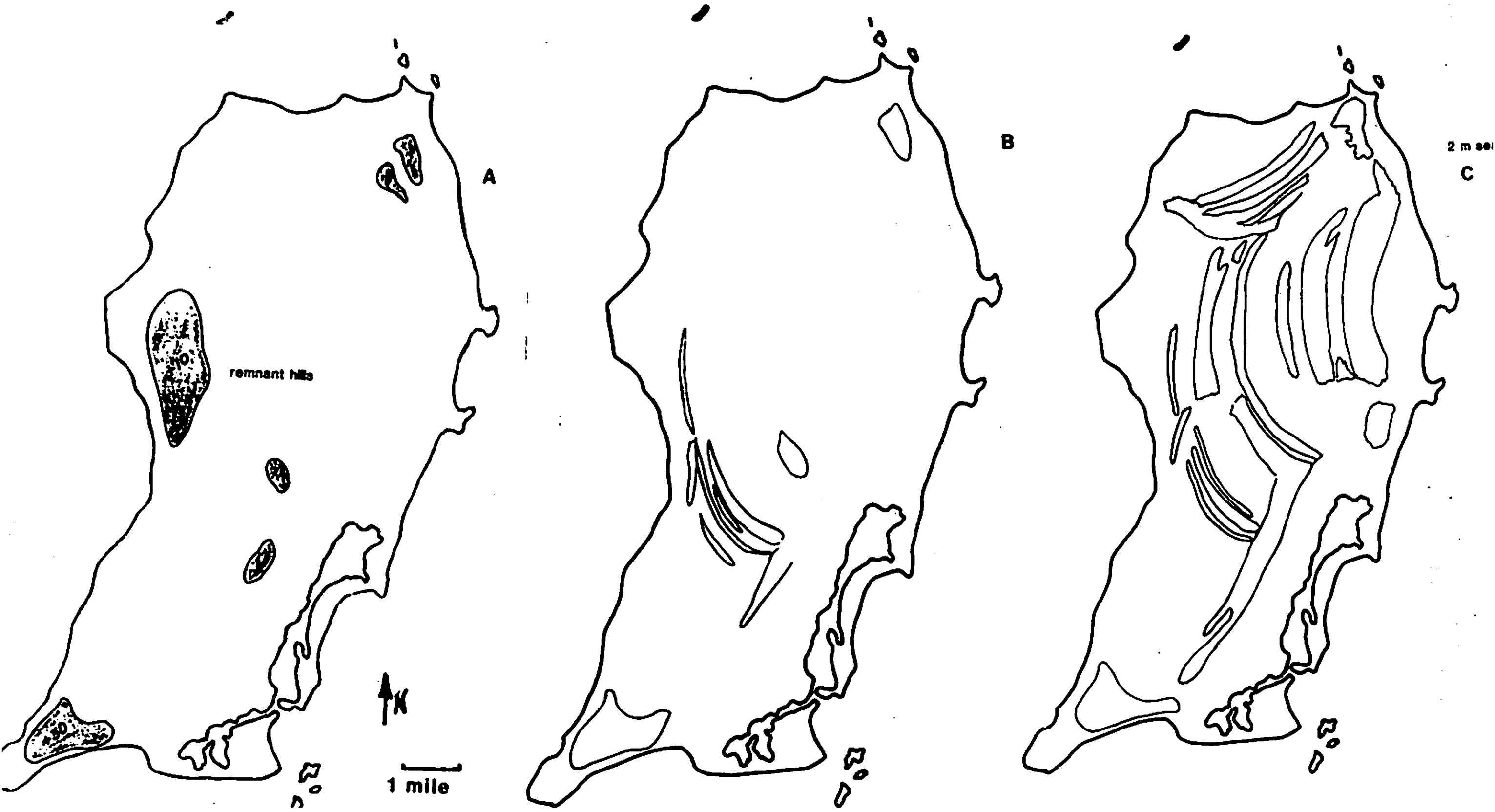
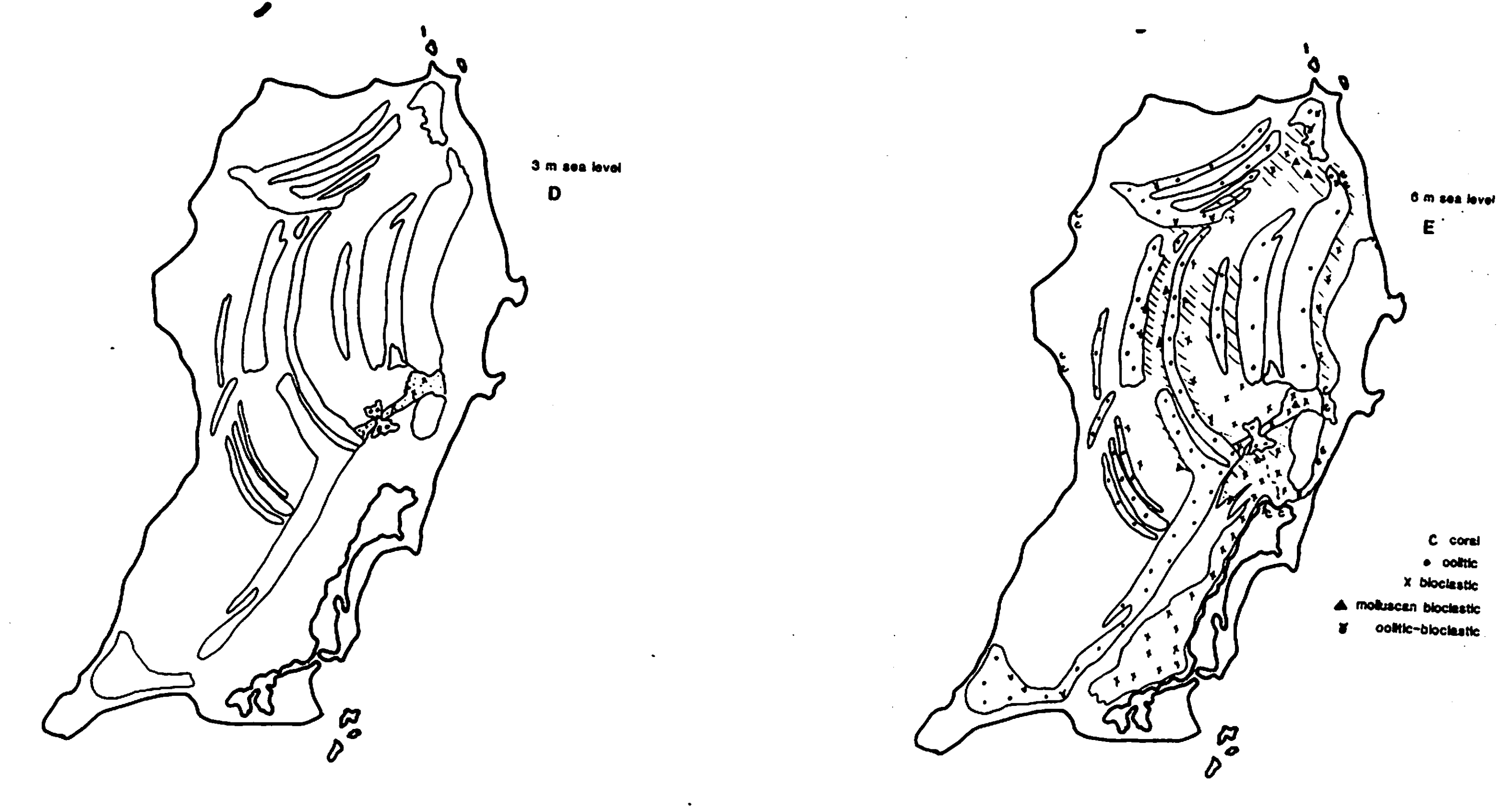


Fig. 7. Interpreted development of landforms and lithofacies during rising sea level stages. a) Initial flooding of paleosol-covered bank possessing remnant hills; b) Formation of oolite ridges controlled in part by location of remnant hills; c) Development of large arcuate oolite dune ridges anchored by remnant hills (+2 m sea level); d) Influx of bioclastic sediment at +3 m sea level. Bioclastic ridge restricts Granny Lake area and forms oolite tidal delta; and e) Reef development, bioclastic benches and lowland deposits, localized molluscan facies on leeward sides of ridges (+6 m sea level). Tidal delta at Quarry E and ridge separates Stouts Lake from Pigeon Creek area.



(20 ft), coral reefs developed along the bank margins (Fig.7e). In combination with the previously formed dune ridges, these reefs restricted wave energy reaching the interior of San Salvador. As a result water of the inter-ridge lagoons was not suitable for a normal marine fauna and flora, however, certain molluscan species flourished. On western shores of these lagoons, many of which are presently lakes, reworked bioclastic and peloidal sediment was washed into lagoonal beaches. On eastern shores, leeward of the ridges, however, sediment was not reworked and the molluscan bioclastic packstone/wackestone accumulated. Mollusc valves commonly remain hinged and many are in apparent growth position.

At this time, perhaps 120,000 ybp, sea level had reached its maximum highstand at +6 m (20 ft). The Cockburn Town reef flourished as did numerous coral growth centers on the bank margin. Peloidal-bioclastic sedimentation dominated both on bank margins and in interior lagoons. Processes similar to those active in south Pigeon Creek developed a tidal delta at Quarry E as described by Teeter & Thalman (1984). At the same time the bioclastic dune ridge separating Stouts Lake and Pigeon Creek developed.

As sea level dropped following the 120,000 ybp maximum, sedimentation decreased and eventually ceased in the San Salvador interior.

CONCLUSIONS

Oolitic dune ridges in the interior of San Salvador formed during a rising sea level event rather than during a dropping sea level event as previously suggested. Lithofacies composition, distribution and sequences, sedimentary structures, and landforms support this interpretation. Published sea level curves for the past 140,000 years also testify to the requirement that all Sangamonian deposits must be deposited during a single highstand.

Eastward progradation of dunal ridges was in response to accelerated sedimentation rates rather than regression related to a falling sea level.

ACKNOWLEDGMENTS

I want to thank Donald and Kathy Gerace and the staff of the Bahamian Field Station for their financial and logistical support of my research while on San Salvador.

REFERENCES CITED

Carew, J.L. and Mylroie, J.E., 1987, A refined geochronology for San Salvador Island, Bahamas: in Curran, H.A., ed., Proceedings of the Third Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 35-44.

Carew, J.L. and Mylroie, J.E., 1986, The Pleistocene and Holocene stratigraphy of San Salvador Island, Bahamas, which reference to marine and terrestrial lithofacies at French Bay: in Curran, H.A., ed., Pleistocene and Holocene carbonate environments on San Salvador Island, Bahamas: Field Trip No. 1 Guidebook, Society of Economic Paleontologists and Mineralogists, Bahamian Field Station, Ft. Lauderdale, FL, p. 11-62.

Carew, J.L., Mylroie, J.E., Wehmiller, J.F. and Lively, R.A., 1984, Estimates of Late Pleistocene sea level high stands from San Salvador, Bahamas: in Teeter, J.W., ed., Proceedings of the Second Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 153-176.

Chappell, J. and Veeh, H.H., 1978, Late Quaternary tectonic movements and sea-level changes at Timor and Atauro Island: Geological Society of America Bulletin, v. 89, p. 356-368.

Curran, H.A. and White, B., 1984, Field guide to the Cockburn Town coral reef, San Salvador, Bahamas: in Teeter, J.W., ed., Proceedings of the Second Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 71-96.

Curran, H.A., White, B., Chen, J.H., and Wasserburg, G.J., 1989, Comparative morphologic analysis and geochronology for the development and decline of two

Pleistocene coral reefs, San Salvador and Great Inagua Islands, Bahamas: in Mylroie, J., ed., Proceedings of the Fourth Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 107-117.

Florentino, E., 1985, Distribution, petrographic analysis and origin of the Granny Lake oolite, San Salvador Bahamas: Unpublished MS thesis, University of Akron, Akron, OH, 99 p.

Florentino, E. and Bain, R.J., 1984, Environment of deposition of the Granny Lake oolite, San Salvador, Bahamas: in Teeter, J.W., ed., Proceedings of the Second Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 187-196.

Goldhammer, R.K., Dunn, P.A., and Hardie, L.A., 1987, High frequency glacio-eustatic sea level oscillations with Milankovitch characteristics recorded in Middle Triassic platform carbonates in northern Italy: American Journal of Science, v. 287, p. 853-892.

Hebert, J.P., 1991, A lithofacies analysis of the northern portion of San Salvador Island Bahamas: Unpublished MS thesis, University of Akron, Akron, OH, 69 p.

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: Bahamian Field Station, Ft. Lauderdale, FL, p. 197-208.

Mesolella, K.J., Matthews, R.K., Broecker, W.S. and Thurber, D.L., 1969, The astronomical theory of climatic change: Barbados data: Journal of Geology, v. 77, p. 250-274.

Pinter, N. and Gardner, T.W., 1989, Construction of the polynomial model of glacio eustatic fluctuation: Estimating paleo-sea levels continuously through time: Geology, v. 17, p. 295-298

Sims, W.R., 1987, Facies analysis of carbonate rocks on the southern end of San Salvador Island, Bahamas: Unpublished MS thesis, University of Akron, Akron, OH, 135 p.

Szabo, B.J., Hattin, D.E. and Warren, V.L., 1988, Age of fossil reef at Grotto Beach, San Salvador, Bahamas, and its implication regarding sea level during the last interglacial high stand: (Abstract) American Quaternary Association, Program and Abstracts, 10th Biennial Meeting, Amherst, p. 93.

Teeter, J.W. and Thalman, K.L., 1984, Second symposium on the geology of the Bahamas field trip to Pigeon Creek: in Teeter, J.W., ed., Proceedings of the Second Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 177-186.

Thalman, K.L., 1983, A Pleistocene Lagoon and its modern analogue, San Salvador, Bahamas: Unpublished MS thesis, University of Akron, Akron, OH, 166 p.

Titus, R., 1987, Geomorphology, stratigraphy and the Quaternary history of San Salvador: in Curran, H.A., ed., Proceedings of the Third Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 155-164.

Veeh, H.H. and Chappell, J.M.A., 1970, Astro nomic theory of climatic change: support from New Guinea: Science, v. 167, p. 862-865.

White, B., 1989, Field guide to the Sue Point fossil coral reef, San Salvador Island, Bahamas: in Mylroie, J.E., ed., Proceedings of the Fourth Symposium on the Geology of the Bahamas: Bahamian Field Station, Ft. Lauderdale, FL, p. 353-365