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Comparative Morphologic Analysis and Geochronology for the Development and Decline of Two Pleistocene Coral Reefs, San Salvador and Great Inagua Islands, Bahamas

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ABSTRACT

Sizeable bank/barrier coral reefs of Sangamon age crop out along the coast at Cockburn Town on San Salvador and at Devil's Point on Great Inagua. The Cockburn Town reef has been mapped, and the relationships between various parts of the reef, lithofacies contacts, and modern sea level have been established precisely. At Devil's Point, three detailed profiles have been surveyed relative to high tide line.

^{238}U-^{234}U-^{230}Th dates were determined for sixteen coral samples from the Cockburn Town reef and three coral samples from the Devil's Point reef using recently developed mass spectrometric techniques for the measurement of ^{230}Th abundance. Typical errors are ±1.5 ky. This narrow error range permits detailed chronologic study with time resolution adequate to define stages of the reef's history. The initial stage of reef development is not revealed at either site, but the main parts of both reefs are well preserved. The Cockburn Town reef existed by 130 kybp and an *Acropora palmata* reef crest with adjacent patch reefs flourished between 124 to 121 kybp. By 119 kybp the reef was in decline. Total longevity of the Cockburn Town reef was about 12 ky. In the vicinity of the measured profiles at Devil's Point, an *A. cervicornis*-dominated rubblestone and corals preserved in growth position have been bevelled off, apparently representing an ancient wave-cut surface. A patch reef dominated by *Montastrea annularis* and *Diploria* sp. overlies the bevelled surface. Three coral ages from Devil's Point range from 125 to 122 kybp, corresponding to the time when the Cockburn Town reef also was flourishing.

As Wisconsinan glaciation expanded, the resulting fall in sea level led to the progressive burial of the reefal facies at both sites by subtidal, then beach, and finally dunal sands.

INTRODUCTION

Brief and usually sketchy reports of reefal facies of presumed Pleistocene age in the carbonate rocks that cap the Bahamas have been made in various geologic and geographic surveys over the years from a number of Bahamian islands. However, except for the Cockburn Town fossil coral reef on San Salvador, none of the larger fossil coral reefs in the Bahamas have been described in any detail. The well exposed patch reef complex at Sue Point on San Salvador recently has been mapped and studied by White (this volume).

The Cockburn Town reef is the largest fossil coral reef on San Salvador Island. The reef was described briefly by Moshier and others (1979). A detailed facies map of the reef and a thorough field description of its geologic and paleontologic setting based on the map and a series of five stratigraphic profiles was given by Curran and White (1984, 1985). The shallowing-upward facies associated with the reef were described and an analysis of the carbonate cements stratigraphy of the sequence was made by White and others (1984). On Great Inagua Island, the general geologic setting of the large fossil coral reef at Devil's Point was described by White and Curran (1987).

The purposes of this paper are to describe further the paleogeographic setting and history of development and decline of the Cockburn Town reef, to describe the setting and three stratigraphic profiles from the Devil's Point reef, and to integrate into the reef developmental models sixteen radiometric dates from corals of the Cockburn Town reef and three dates from corals of the Devil's Point reef. In addition, we will discuss the significance of these dates for interpretation of the developmental history of these two reefs and for the understanding of eustatic sea level change during that part of Sangamon time represented by the reefs. Length limitations for this paper prohibit extended discussion of the developmental model for the Cockburn Town reef; our ideas are succinctly outlined in the figures within. We expect that several more radiometric dates will be forthcoming from both reefs to expand and fill in remaining gaps of coverage at each site. These dates and results from some further refinement of the dates presented herein will be given in a future publication.

THE GEOLOGIC SETTING

The Cockburn Town Fossil Coral Reef

The Cockburn Town reef is located along the western coast of San Salvador Island, northwest of the center of Cockburn Town (Fig. 1). Reefal rocks extend in a northwesterly direction from the old town dock for a distance of about 650m, terminating near an abandoned cable trench cut into Pleistocene shallow subtidal and beach calcarenites that flank and overtop the reef at its northern end.

The geologic map of the reef and its associated facies (Fig. 2) and five detailed stratigraphic profiles from the reef area originally were published by Curran and White (1984, 1985). Reference starter points for map and profiles topography were nearby bench marks that were tied directly to accurately measured mean sea level (Adams, 1980). The reef ultimately was buried by a sequence of calcarenites deposited in shallow subtidal environments and grading up to a beach and then dunal environment. This shallowing-upward sequence and the diagenetic history of the reef complex with respect to sea level change were discussed by White and others (1984).

The Cockburn Town and Devil's Point reefs are excellent fossil examples of bank/barrier reefs as defined by Kaplan (1982). Such reefs are common today on the narrow, wave-cut shelves of islands in tropical western Atlantic and Caribbean waters. Modern bank/barrier reefs (such as

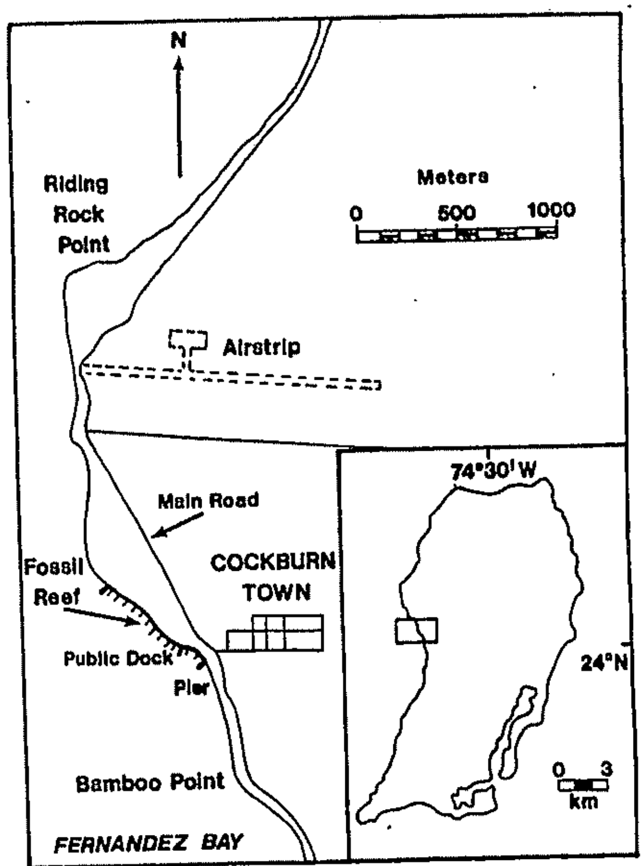

Fig. 1. Location of the Cockburn Town fossil coral reef on San Salvador Island.

the Gaulins Reef off of the north coast of San Salvador) normally are only hundreds of meters from a land mass, not thousands of meters offshore as is the case for true barrier reefs. Bank/-barrier reefs also are much shorter in linear extent than barrier reef complexes. Our paleogeographic reconstruction of the Cockburn Town reef as a bank/barrier reef with associated patch reefs, lying about 450 m offshore and flourishing in the time period about 124,000 to 121,000 years ago is shown in Figure 3. This reconstruction is based on the map of the reef (elevations of major coral types and facies contacts), reconstruction of the growth heights of the reef crest corals (*Acropora palmata*), and the cluster of reef crest coral age dates, as will be discussed subsequently.

The Devil's Point Fossil Coral Reef

The Devil's Point reef is found along the west coast of Great Inagua Island flanking both sides of Devil's Point (Fig. 4.). This bank/barrier reef is much larger than the Cockburn Town reef; it extends for several kilometers around Devil's Point. The general geologic setting of this reef was described by White and Curran (1987). Again

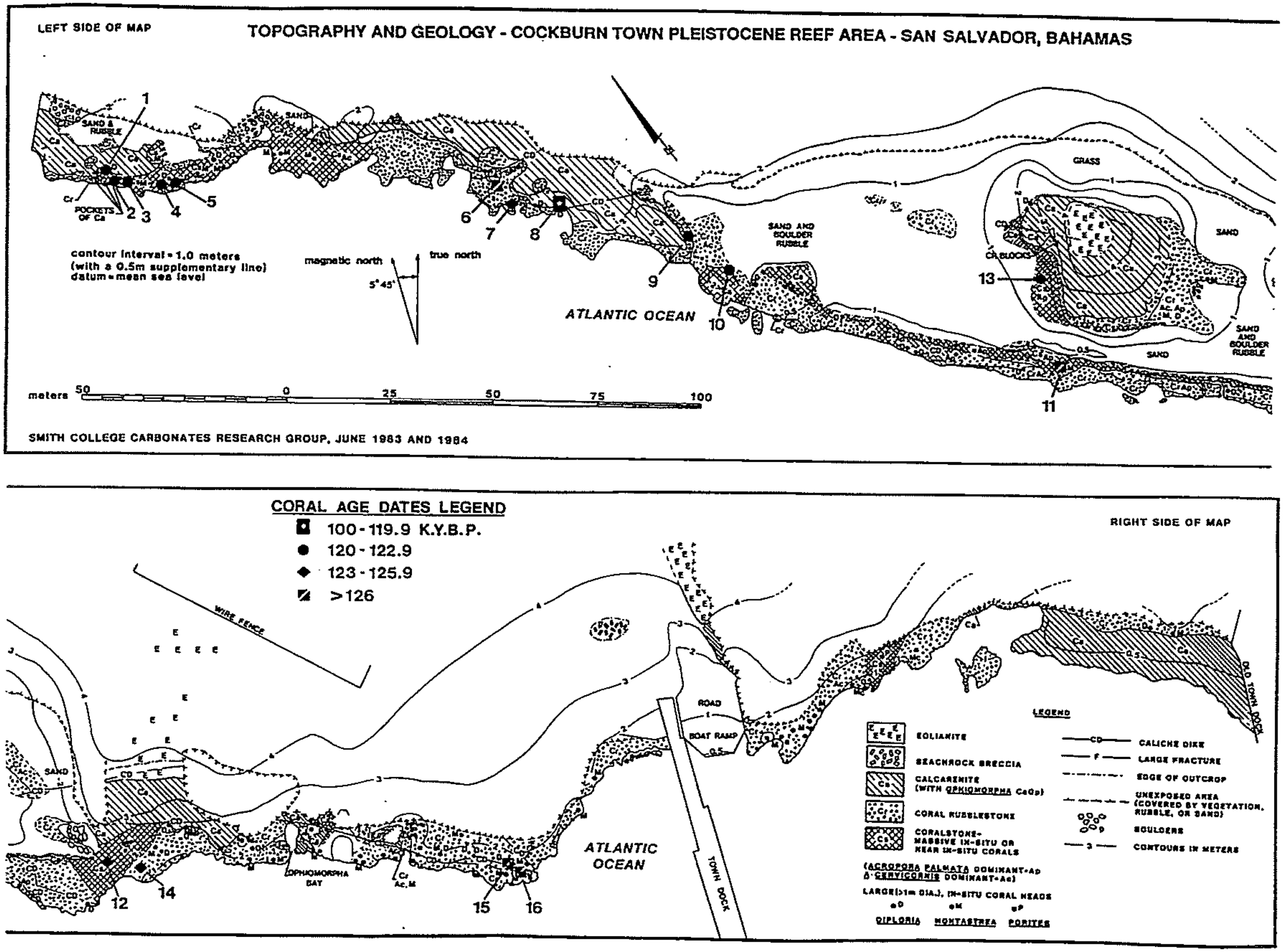

Fig. 2. Geologic map of the Cockburn Town coral reef. Numbers indicate locations of radiometrically dated coral samples as given in Table 1.

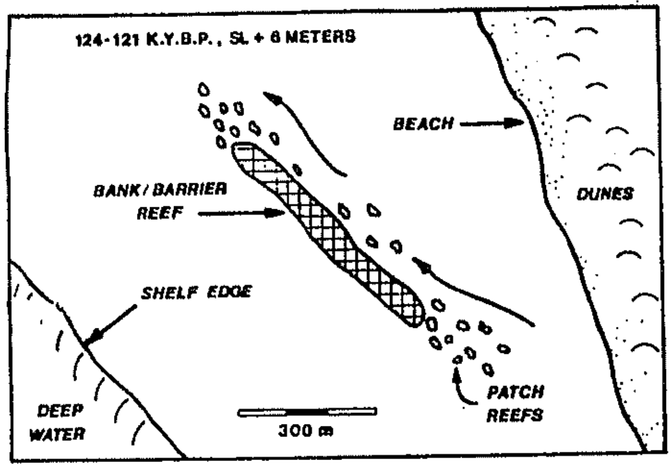

Fig. 3. Paleogeographic reconstruction of the Cockburn Town coral reef at time of its maximum development about 124-121 kybp.

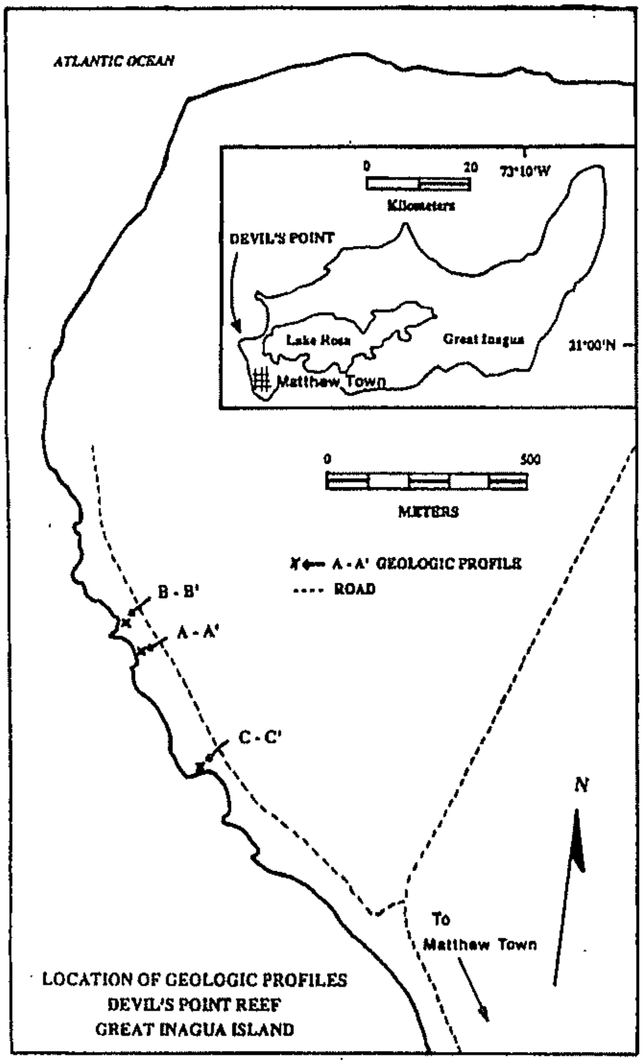

Fig. 4. Location of the Devil's Point fossil coral reef on Great Inagua Island, with locations of Profiles A-A' (Fig. 14), B-B' (Fig. 15), and C-C' (Fig. 5).

a shallowing-upward sequence of calcarenite facies caps the reefal complex.

The large size and remoteness of the Devil's Point reef have prohibited the making of a geologic map, but three detailed stratigraphic profiles as located on Figure 4 have been carefully surveyed. Probably the general history of development and decline of this reef is similar overall to that of the Cockburn Town reef, but at least one major difference in the developmental sequence has been recognized, as will be discussed later.

RADIOMETRIC DATES

Background

A total of nineteen radiometric dates, sixteen dates from the Cockburn Town reef and three dates from the Devil's Point reef, have been obtained from fossil coral samples. These ^{238}U-^{234}U-^{230}Th dates were determined by J.H. Chen and G.J. Wasserburg using their newly developed mass spectrometric technique for the measurement of ^{230}Th abundance (Edwards and others 1987a,b). Typical errors for dates from this method are $\pm$1.5 ky (2 sigma); this is about 5 to 10 times smaller than the error range for alpha counting. These low error range dates permit detailed chronologic study of a reef and, in the case of the Cockburn Town reef, with time resolution sufficient to bracket closely the timing of stages of development of the reef. A summary of data for the nineteen dated coral samples is given in Table 1.

Cockburn Town Reef Dates

The locations of dated coral samples from the Cockburn Town reef are marked on the geologic map of the reef (Fig. 2). Samples of five different coral species have been dated from the reef, and we think that the dates are fully species independent. If there is a problem coral species, it would seem to be *Diploria clivosa*, the encrusting brain coral. *D. clivosa* sample CT-6 from Cockburn Town and sample DP-3 from Devil's Point gave dates that were somewhat older than we would have predicted given that this species most commonly is a shallow water encruster.

The oldest coral dated from the Cockburn Town reef is an *Acropora palmata* specimen (sample CT-11) at 130.75$\pm$1.5 ky, and the youngest coral date is 119.2$\pm$1.5 ky from a *Diploria*

SAMPLE NUMBER	SCLERACTINIAN CORAL SPECIES	AGE IN K.Y.B.P.	PRESERVATIONAL SETTING	ELEVATION ABOVE SEA LEVEL (in meters)
COCKBURN TOWN REEF, SAN SALVADOR				
1	*Montastrea annularis*	120.0 ± 1.4	growth position	+2.25
2	*M. annularis*	120.5 ± 1.4	" "	+2.25
3	*Diploria strigosa*	122.1 ± 1.2	" "	+2.25
4.	*D. clivosa*	121.8 + 1.3	encruster in growth position	+1.5
5	*M. annularis*	122.7 ± 1.3	growth position	+2.25
6	*D. clivosa*	128.7 ± 1.2	encruster in growth position	+1.5
7	*Acropora cervicornis*	124.2 ± 2.2	in coral rubblestone, close to growth location	+1.5
8	*D. strigosa*	119.2 + 1.5	growth position	+2.0
9	*A. palmata*	121.2 ± 1.4	near growth location in coralstone	+1.5
10	*A. palmata*	122.5 ± 1.5	" " " " "	+1.75
11	*A. palmata*	130.75± 1.5	" " " " "	+1.25
12	*A. palmata*	124.6 ± 1.3	" " " " "	+1.5
13	*A. palmata*	123.7 ± 1.6	" " " " "	+1.5
14	*A. cervicornis*	124.7 ± 1.5	in coral rubblestone, close to growth location	+1.5
15	*D. strigosa*	126.3 ± 1.2	growth position	+1.5
16	*M. annularis*	127.1 ± 2.1	" "	+1.25
DEVIL'S POINT REEF, GREAT INAGUA				
1	*M. annularis*	125.1 ± 2.1	in coral rubblestone	See Fig. 5
2	*M. annularis*	122.2 ± 1.3	growth position	" " "
3	*D. clivosa*	123.4 ± 1.5	encruster in growth position	" " "

Table 1. Compilation of data on the radiometrically dated fossil coral samples, including sample numbers as keyed to the Cockburn Town Reef geologic map (Fig. 2) or Devil's Point Profile C-C' (Fig. 5), coral species, age date and error range, coral sample preservational setting, and elevation of sample above sea level.

strigosa specimen (sample CT-8). Thus we know that the reef existed and flourished during the Sangamon interglacial, at the time of oxygen isotope substage 5e of Shackleton and Opdyke (1973) and as previously reported by Carew and Mylroie (1987). Our span of coral age dates from the Cockburn Town reef indicates a minimum longevity for the reef of 12,000 years. Furthermore, the age dates can be used to bracket the timing of reef developmental stages as discussed in the next section.

The patch reef corals at the northwest end of the Cockburn town reef yielded generally younger age dates than the middle section of the reef, the *Acropora palmata* reef crest area, and the patch reefs at the southeast end of the reef (Fig. 2). We think that this largely is the result of topographic control, with the samples from the northwest end of the reef having a higher topographic position. It also could be that the reef grew in a northwesterly direction. We favor the former interpretation, because we think that the shallow water and encruster corals that are common in the northwest area of the reef (see later discussion) and the overlying calcarenite beds truly are higher up in the reef sequence. One must remember that a modern bank/barrier reef develops with significant topographic relief (at least 6 m at Gaulins reef). In a fossil reef complex, the preservation of corals would not have occurred in a layer-cake fashion; instead considerable complexity with regard to age relationships between adjacent fossil corals should be expected.

Carew and Mylroie (1987, Fig. 1) reported three U-series dates from corals of the Cockburn Town reef. Two of these dates (error range of 12 ky) fit well into our range of dates. A third date of 171±15 ky from a *Diploria strigosa* rubble chunk is much older than any date we obtained. Carew and Mylroie postulated that the old coral was washed as rubble into the Cockburn Town reef complex and preserved there, and that its age suggests an earlier flooding event for the San Salvador shelf. This may have been the case, but we cannot confirm the hypothesis with any of our age dates.

Devil's Point Reef Dates

Three U-series age dates have been determined from coral samples taken along Profile C-C' at Devil's Point (Fig. 5, see also Table 1). In the area of Profile C-C', a well preserved, *in situ* patch reef lies on top of a wave-cut surface with underlying coral rubblestone. A *Montastrea annularis* specimen from below the wave-cut surface yielded an age of 125.1±2.1 ky. Samples from above the wave-cut surface gave age determinations of 122.2±1.3 ky and 123.4±1.5 ky.

The aggregate dates indicate that the Devil's Point reef existed contemporaneously with the Cockburn Town reef and flourished during Sangamon stage 5e time. The vertical spread of dates suggests that the wave-cut surface may reflect a short-lived sea level low-stand during the time interval of stage 5e. However, caution is warranted at this time because the error bars of the three samples somewhat overlap. Clearly more age determinations are needed before a complete history of the Devil's Point reef can be related.

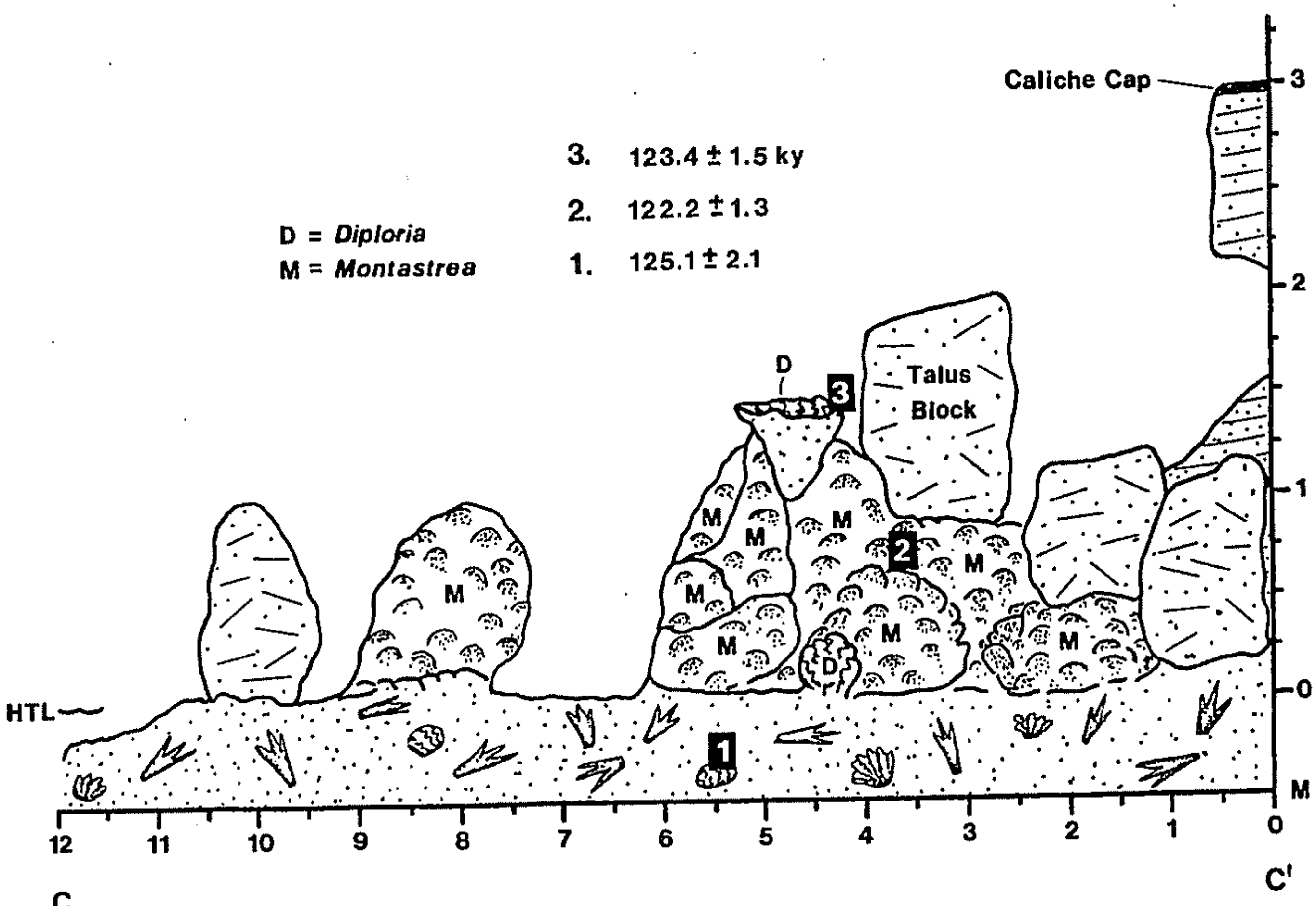

Fig. 5 Profile C-C' from the Devil's Point coral reef. The wave-cut bench occurs at top of the coral rubblestone (basal unit of the profile) and below the in situ patch reef. Locations also are shown for the three radiometrically dated coral samples as given in Table 1.

REEF DEVELOPMENT AND DECLINE

The Cockburn Town Reef

Colonization Stage

The initial stage of reef development at the Cockburn Town site is not revealed in outcrop, but the reef probably began with the colonization of hardground areas by *Acropora palmata* and other corals (Fig. 6) as rising seas encroached upon the San Salvador shelf more than 130 ky before present. An *Acropora palmata* sample (CT-11) yielded an age of 130.75±1.5 ky, indicating that the reef was established by that time. Patch reefs at the flanks of the developing bank/barrier reef were growing by 127 kybp (*Montastrea annularis* sample, CT-16).

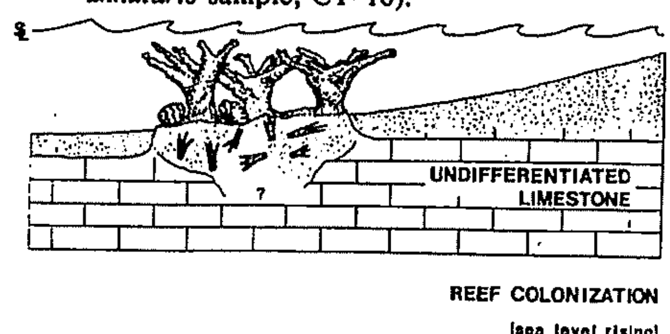

Fig. 6. Colonization stage of development of the Cockburn Town coral reef, greater than or about 130 kybp.

Maturity Stage

The crest of Bahamian bank/barrier reefs is formed by the frame-building coral *Acropora palmata*. Four of the five *A. palmata* samples from the Cockburn Town reef (samples CT-9, 10, 12, 13) fall in the time range of 124.6 to 121 kybp, indicating that the reef crest and adjacent patch reefs flourished at this time (Fig. 7). *A. palmata* coral heads grew upward to mean low sea level, which we think was about 6 m above present mean low sea level (based on our geologic/topographic map of the reef area, with no correction for tectonic subsidence). At that time, the reef lay about 450 m offshore (Fig. 3).

Reef Decline and Partial Burial

The sedimentary sequence of the reef and its overlying beds indicates that the reef began to decline (Fig. 8) as trough cross bedded, subtidal sands transported by longshore currents encroached on the reef (Fig. 9). Living patch reef

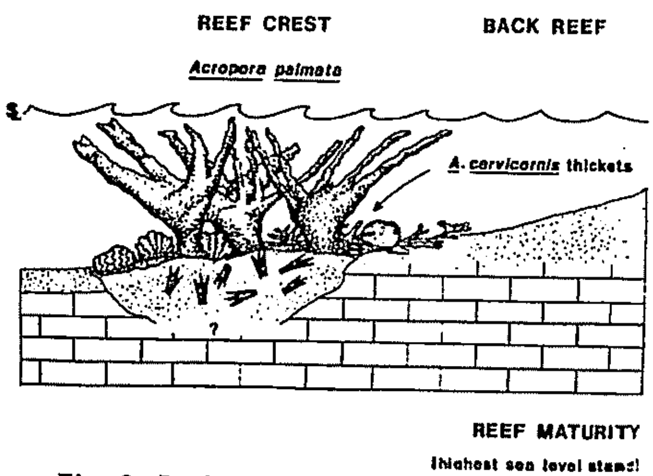

Fig. 8. Decline stage of the Cockburn Town coral reef, about 120 kybp.

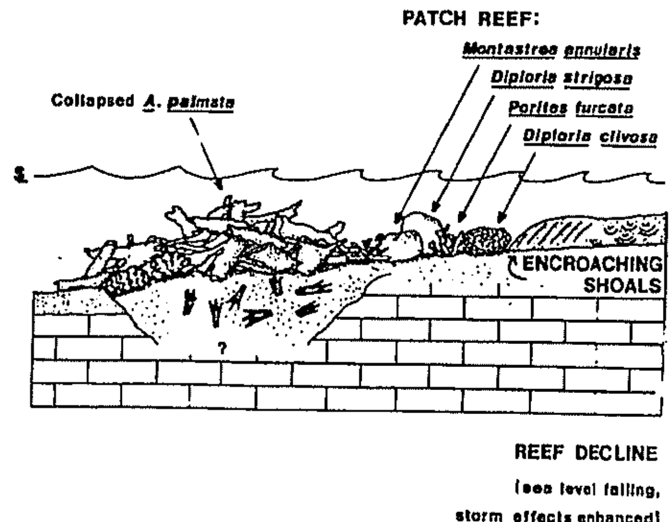

Fig. 7. Full maturity stage of development for the Cockburn Town coral reef, between 124-121 kybp.

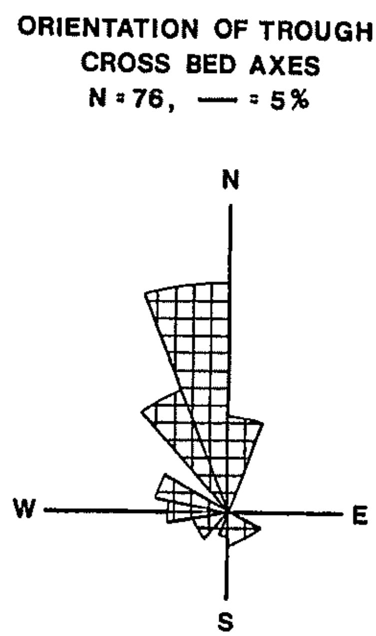

Fig. 9. Rose diagram plot of orientations of trough cross bed axes in calcarenites of subtidal beds topping the Cockburn Town coral reef.

corals were present in at least the northwest area of the reef until 120 to 119 kybp (samples CT-1, 2, 8). Particularly prominent in this area of the reef are the shallow-water corals *Porites furcata* and *Diploria clivosa* (Curran and White, 1984, 1985). At about this time, a thick bed of tabular cross bedded sand was deposited by a storm, very possibly a hurricane, and this sand layer covered much of the reef, terminating active growth (Fig. 10, 11, and White and others, 1984).

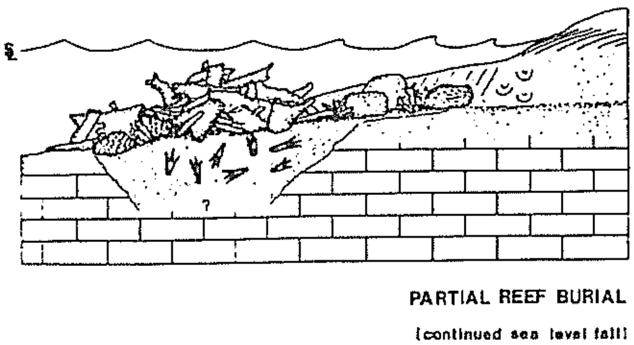

Fig. 10. Partial burial stage of the Cockburn Town coral reef, about 119 kybp.

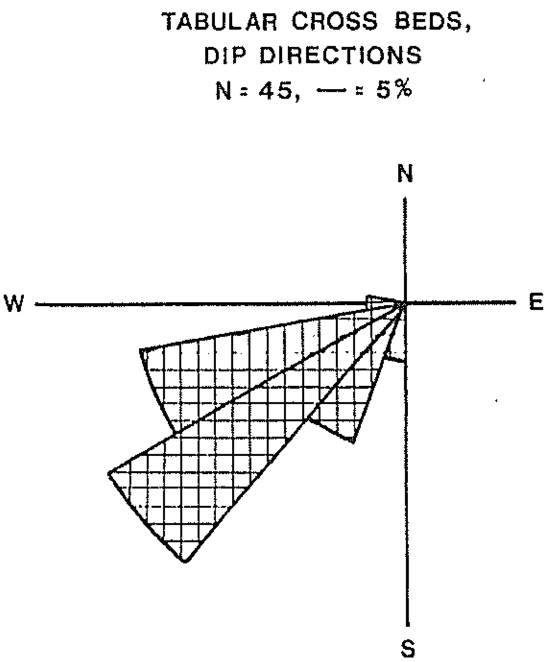

Fig. 11. Rose diagram plot of dip directions of the set of tabular cross beds in the calcarenites that cap the Cockburn Town coral reef.

Complete Burial

With the onset of Wisconsinan glaciation and continued falling sea level, sands packed around and ultimately over all remaining coral heads of the reef. The shallowing-upward sequence continued with the deposition of beach sediments and was completed by the deposition of dunal sands (Fig. 12, and White and others, 1984).

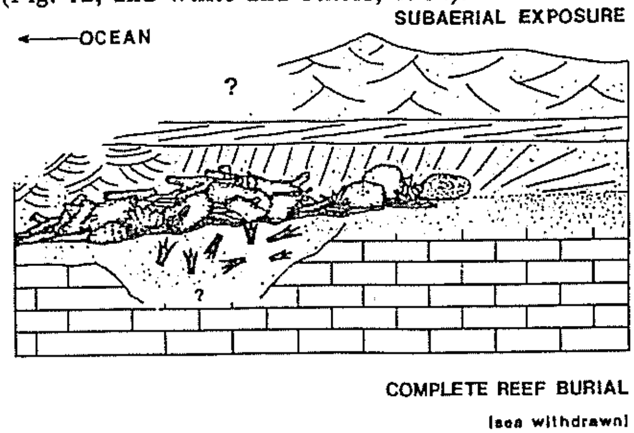

Fig. 12. Complete burial of the Cockburn Town coral reef, shortly after 119 kybp.

Summation

The major events from full maturity to burial of the Cockburn Town reef are summarized in the profiles of Figure 13. The development and

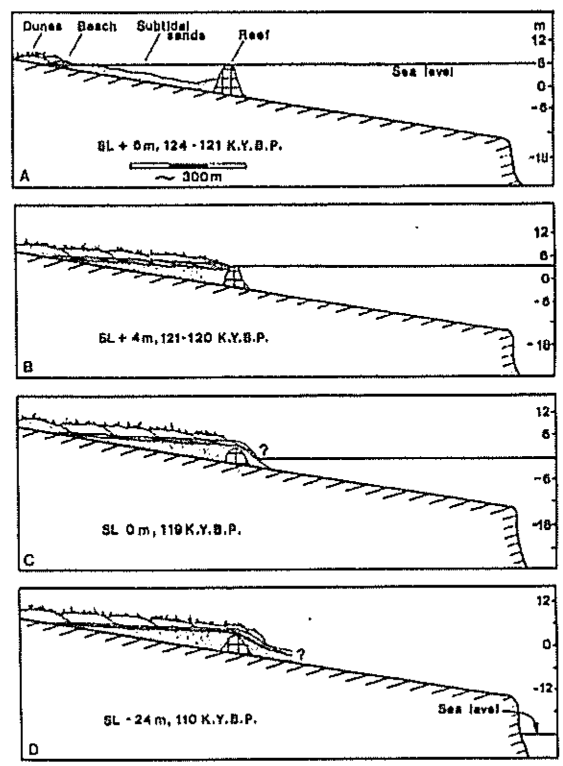

Fig. 13. Profile reconstructions of the Cockburn Town coral reef from time of its maximum development (A) to complete burial (D). Sea level positions for profiles A-C from our reconstruction of the Cockburn Town reef; sea level position for profile D from Harmon and others (1983) curve for Bermuda.

eventual decline and burial of the reef occurred over a minimum period of about 12,000 years, with full maturity at about 124 kybp (Fig. 13A). Subsequently sea level began to fall (Fig. 13B), and by shortly after 119 kybp the reef was buried (Fig. 13C). By 110 kybp, sea level had fallen to a point below the shelf/slope break off San Salvador (Fig. 13D, and Harmon and others, 1983).

Devil's Point Reef

The extensive bank/barrier fossil reef at Devil's Point on Great Inagua Island has not been studied in the detail of the Cockburn Town reef, but three surveyed profiles have been made across the reef (Figs. 5, 14, 15). The major facies of these profiles is coral rubblestone (Facies 1, Figs. 14, 15) dominated by chunks of *Acropora cervicornis* and *A. palmata* with large heads of *in situ Montastrea annularis* and *Diploria strigosa*. The top of this facies has been bevelled off and apparently represents an ancient wave-cut platform.

In the area of Profile C-C' (Fig. 5), an extremely well-preserved, *in situ* fossil patch reef lies on top of the wave-cut surface. This patch reef assemblage is dominated by *Montastrea annularis* with subordinate *Diploria strigosa* and

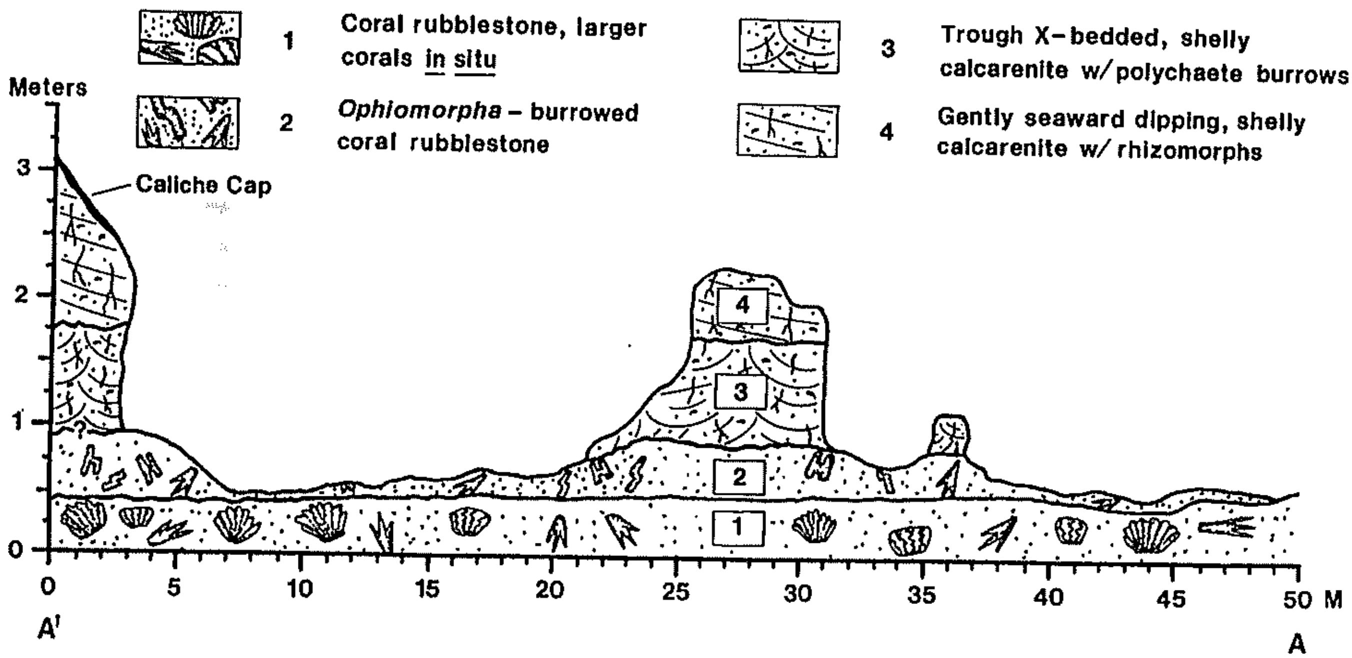

Fig. 14. Profile A-A' from the Devil's Point coral reef. A wave-cut bench occurs at the top of Facies 1 on this profile and Profile B-B' (Fig. 15).

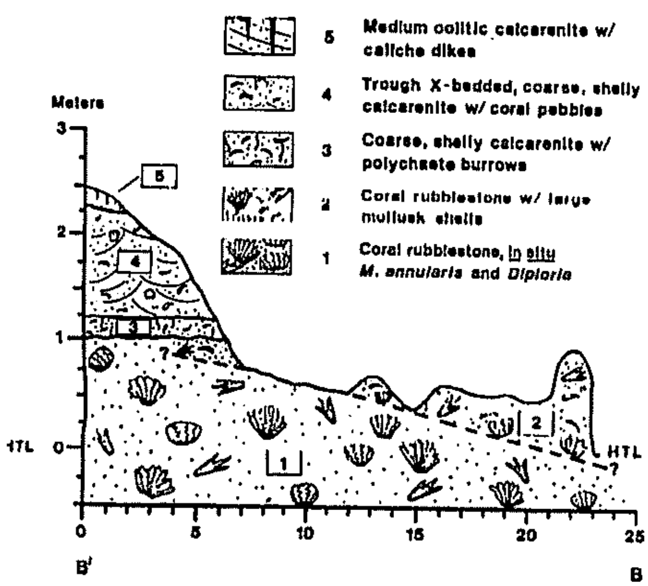

Fig. 15. Profile B-B' from the Devil's Point coral reef.

D. clivosa. The physical relationships suggest that the wave-cut surface may reflect a short-lived sea level low-stand during the time interval of stage 5e, and, as discussed previously, this is at least somewhat supported by the vertical sequence of age dates from coral samples taken along Profile C-C'. However, further work will be needed to verify this interpretation. As with the Cockburn Town reef, the stratigraphic sequence at Devil's Point reveals ultimate termination of the reef by burial during sea regression (White and Curran, 1987).

CONCLUSIONS

1. Based on sixteen age dates derived by mass spectrometric analysis of ^{230}Th abundance in coral specimens, the Cockburn Town reef on San Salvador Island had a *minimum* longevity of 12,000 years, from about 131 ky to 119 kybp. The *Acropora palmata* reef crest of this bank/barrier reef flourished in the period 124-121 kybp. Exposed patch reef corals at the southeast end of the reef are relatively old, whereas those at the northwest end are relatively young. This probably is a topographic-erosional effect.

2. The combination of paleontologic, stratigraphic, and age dating using the new mass spectrometric analysis techniques permits the recognition and time bracketing of several major stages in the development of the Cockburn Town reef, from achievement of full maturity, to decline with shallowing conditions, and finally complete burial.

3. The coral age dates from the Devil's Point reef on Great Inagua range from 125 ky to 122 kybp, corresponding to the time when the Cockburn Town reef also flourished. The wave-cut surface within the Devil's Point reef may reflect a short-lived sea level low-stand during the time interval of Sangamon stage 5e.

4. As Wisconsinan glaciation expanded, the resulting fall in sea level led to progressive burial of the reefal facies at both sites, by subtidal, then beach, and finally dunal sands after about 119 kybp.

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REFERENCES CITED

Adams, R.W., 1980, General guide to the geological features of San Salvador, in Gerace, D.T., ed., Field guide to the geology of San Salvador (1st ed.): San Salvador, Bahamas, CCFL Bahamian Field Station, p. 1-66.

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: San Salvador, Bahamas, CCFL Bahamian Field Station, p. 35-44.

Curran, H.A., and White, B., 1984, Field guide to the Cockburn Town fossil coral reef, San Salvador, Bahamas, in Teeter, J.W., ed., Proceedings of the second symposium on the geology of the Bahamas: San Salvador, Bahamas, CCFL Bahamian Field Station, p. 71-96.

Curran, H.A., and White, B., 1985, The Cockburn Town fossil coral reef, 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: San Salvador, Bahamas, CCFL Bahamian Field Station, p. 95-120.

Edwards, R.L., Chen, J.H., and Wasserburg, G.J., 1987a, ^{238}U-^{234}U-^{230}Th-^{234}Th systematics and the precise measurement of time over the past 500,000 years: Earth and Planetary Science Letters, v. 81, p. 175-192.

Edwards, R.L., Chen, J.H., Ku, T.-L., and Wasserburg, G.J., 1987b, Precise timing of the last interglacial period from mass spectrometric determination of thorium-230 in corals: Science, v. 236, p. 1547-1553

Kaplan, E.H., 1982, A field guide to coral reefs: Boston, Houghton Mifflin Co., 289 p.

Harmon, R.S., and others, 1983, U-series and amino-acid racemization geochronology of Bermuda: Implications for eustatic sea-level fluctuation over the past 250,000 years: Paleogeography, Paleoclimatology, Paleoecology, v. 44, p. 41-70.

Moshier, S.O., and others, 1979, Stratigraphy and facies of a Pleistocene fringing reef at Cockburn Town, San Salvador, Bahamas, Geological Society of America, Abstracts with Programs, v. 11, p. 206.

Shackleton, N.J., and Opdyke, N.D., 1973, Oxygen isotope and paleomagnetic stratigraphy of equatorial Pacific core V-28-238: Oxygen isotope temperatures and ice volumes on a 10^5 year and 10^6 year scale: Quaternary Research, v. 3, p. 39-55.

White, B., this volume, Field guide to the Sue Point fossil coral reef, San Salvador Island, Bahamas.

White, B., and Curran, H.A., 1987, Coral reef to eolianite transition in the Pleistocene rocks of Great Inagua Island, Bahamas, in Curran, H.A., Proceedings of the third symposium on the geology of the Bahamas: San Salvador, Bahamas, CCFL Bahamian Field Station, p. 165-179.

White, B., Kurkjy, K.A., and Curran, H.A., 1984, A shallowing-upward sequence in a Pleistocene coral reef and associated facies, San Salvador, Bahamas, in Teeter, J.W., ed., Proceedings of the second symposium on the geology of the Bahamas: San Salvador, Bahamas, CCFL Bahamian Field Station, pp. 53-70.