HOLOCENE STRATIGRAPHY AND EVIDENCE OF TRANSGRESSION IN THE TEN THOUSAND ISLANDS, SOUTHWEST FLORIDA

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INTRODUCTION

Sea level changes have been recorded throughout geologic history. Florida's Southwest coastline has a thin veneer of Holocene and Pleistocene sediments (Parkinson, 1987) with ages no older than 1.8 million years. This unlithified material overlies a Pliocene limestone with a maximum age of 5 million years (Parkinson, 1987). The current configuration of the coastal wetlands of Florida developed during a slow rise in sea level (~4cm/100 years) over the past 3,200 years (Wanless et al, 1994).

This study was done in Southwest Florida's Ten Thousand Islands region, a complex of barrier islands along the coast, protecting a variety of depositional environments from storm waves in the Gulf of Mexico. Field work took place in the area of Blackwater River and Bay (figure 1) which extends through the coastal bays toward the Gulf of Mexico. This site is part of Rookery Bay National Estuarine Research Reserve. The site was chosen because it is the portion of the estuary that is least disturbed by human impact. As the length of the estuary is nearly 5 kilometers, a variety of recent environments are seen. Unlithified sediments in and beneath these environments record eustatic changes over the Holocene. The dominant morphologic characteristics observed in the study area were the abundance of mangrove islands, oyster bars, and lagoons.

METHODS

Four 3" vibracores were obtained along a transect from Blackwater River through the coastal bays to Gullivans Bay (see figure 1). This was done from a pontoon boat anchored to the substrate. At the time the core was taken, the height of the water was measured in reference to mean high tide as a base-level for the project. Using high tide as a reference elevation, comparisons could be made among cores. Each of the four cores used in this analysis were cut, capped and brought to the lab.

The cores, which recovered all or nearly all of the Holocene sequence, were split open, photographed, and described in detail. Samples were extracted from the core for sediment analysis. Weight percent carbonate from each sample was determined by removing the carbonate fraction with a solution of 10% hydrochloric acid. Next, organic material was removed from the remaining sample using a 30% concentrated hydrogen peroxide solution, allowing for a calculation of weight percent of organics within the samples. Prior to each removal, the sample was dried and weighed, and after each removal samples were rinsed, dried, and weighed. The remaining sample was placed in a series of sieves of 250, 125, and 62 microns to determine the weight percent of coarse grained and fine grained siliciclastics.

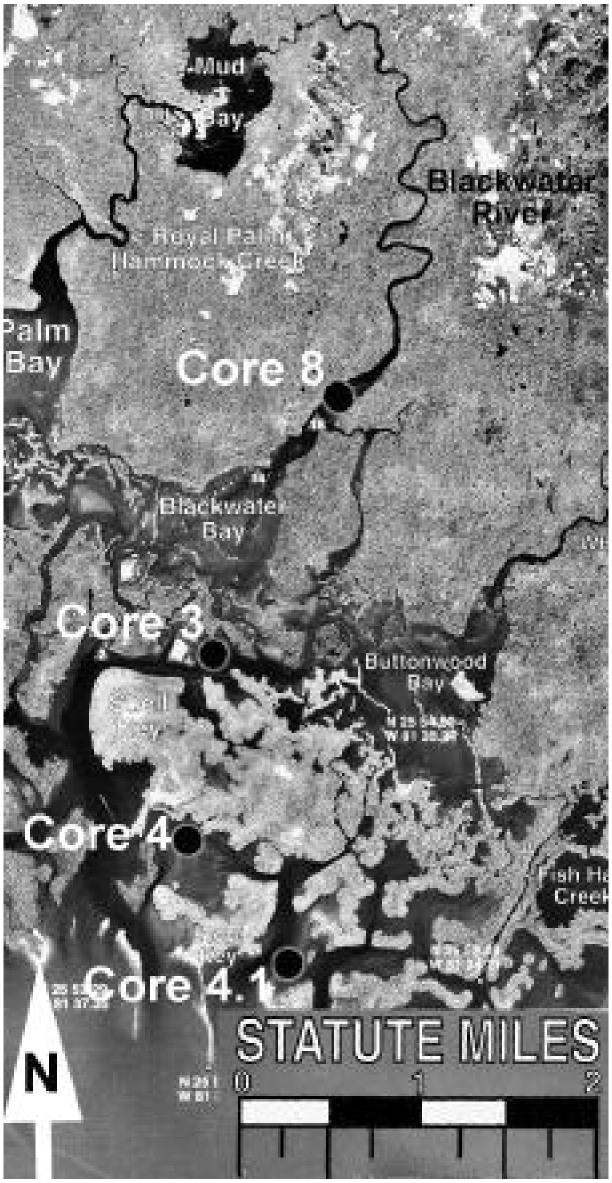

Figure 1 – This air photo of the Blackwater River section of The Ten Thousand Islands, Florida shows the relative locations from which each of the four cores was taken.

RESULTS

The base of core 8 was represented by a clayey quartz sand that is Pleistocene in age (Parkinson, 1987). This was overlain by a shelly- muddy sand. Basal sediments in core 3 were mangrove peats overlain by shelly-muddy sand. Core 4 penetrated the Pliocene carbonate bedrock which was overlain by quartz sand, topped with a shelly-muddy sand. Core 4.1, the distal core in the transect has a sequence beginning with the same Pleistocene clayey quartz sand as found in cores 8 and 4, overlain by the quartz sand which was also found in core 4. A shelly- muddy sand, an oyster boundstone, a mangrove peat, and another shelly-muddy sand are all overlain by the most recent layer, another oyster boundstone.

The mangrove peat of core 4.1 (275cm from the top of the core), which marks the initial flooding of the most distal location in the transect, was dated (4290+/-70ybp) by radiocarbon dating a single shell. The red mangrove peat found at the base of core 3 (2600+/-100ybp) marks the time in which the mangroves were drowned at this location. Due to the locations of the dated material within the two cores, and their locations along the transect, it is apparent that the distal site, from where core 4.1 was extracted, was first affected by the current transgression, with the more proximal sites (4, 3, then 8) inundated later.

All samples from each core contained organic, siliciclastic, and carbonate components. Carbonate material within the cores varied from less than 5 percent to over 50 percent in various samples. Each core displays a general trend of increasing carbonate percent mass with time (figure 2). Organic percentages remained low throughout the entire transect of cores with the exception of the few peaty samples. Sand sized particles in each sample predominate fine grained particles with the exception of samples taken from 300-400cm depth in core 4.1, the outermost core. Fluctuations in the sand sized and fine grained siliciclastic particles are inversely abundant along the length of each core (figure 3).

SUMMARY

Core description and sediment analysis show that no two cores in this study are alike, owing to the time transgressive character of facies in the cores. This rise in sea level is indicated by sediments deposited in shallow water overlain by sediments deposited in deeper waters, as determined by the sediment analysis.

In cores 8,4, and 4.1, an unconformity exists between the basal Pleistocene clayey quartz sand and the overlying layers. Cores 4 and 4.1 both show quartz sand which has been determined to be terrestrial (Tedesco, 2002). The presence of the shelly-muddy sand overlying the quartz sand records the rise in sea level as marine waters drowned the terrestrial quartz sand that is found in cores 4 and 4.1. The mangrove peat of core 3 represents an environment that would be the first indicator in a sea level rise. The overlying shelly-muddy sand which is marine, records inundation of the peat. The dominant modern day sediments in the Blackwater River and bay region are shelly-muddy

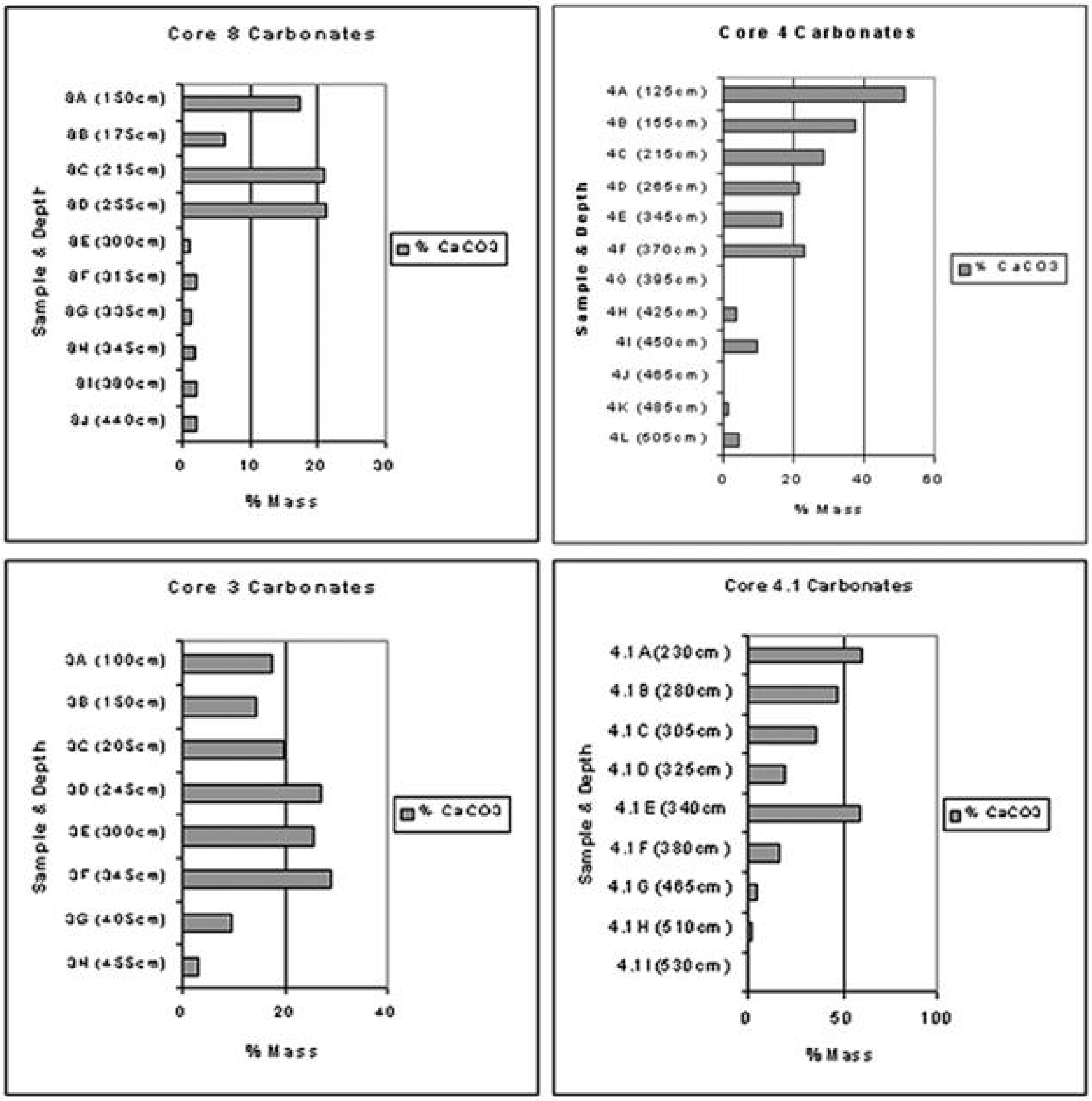

Figure 2 - These carbonate trend graphs show the mass percent of carbonate removed from various depths within the cores in relation to mean high tide. Core 8, which represents the most landward environment shows very low levels of carbonate until the upper half of the core, where there is an abrupt increase, likely indicating a sea level rise. Core 3, shows an increase in carbonate, a slight dip, then again an increase in the most recent sediments represented by the core. Cores 4 and 4.1 both show an increase in carbonate in the sediments to recent times, showing a trending rise in sea

sediments. Shelly-muddy sands overlying the Pleistocene layer shows a flooding of the Pleistocene unconformity allowing deposition to resume. Basal peats of core 3 may overlie the sands. Core 4.1, located in the outermost region of the transect shows a modern unit of oyster boundstone as the oysters have been able to keep pace with the rate of sea level

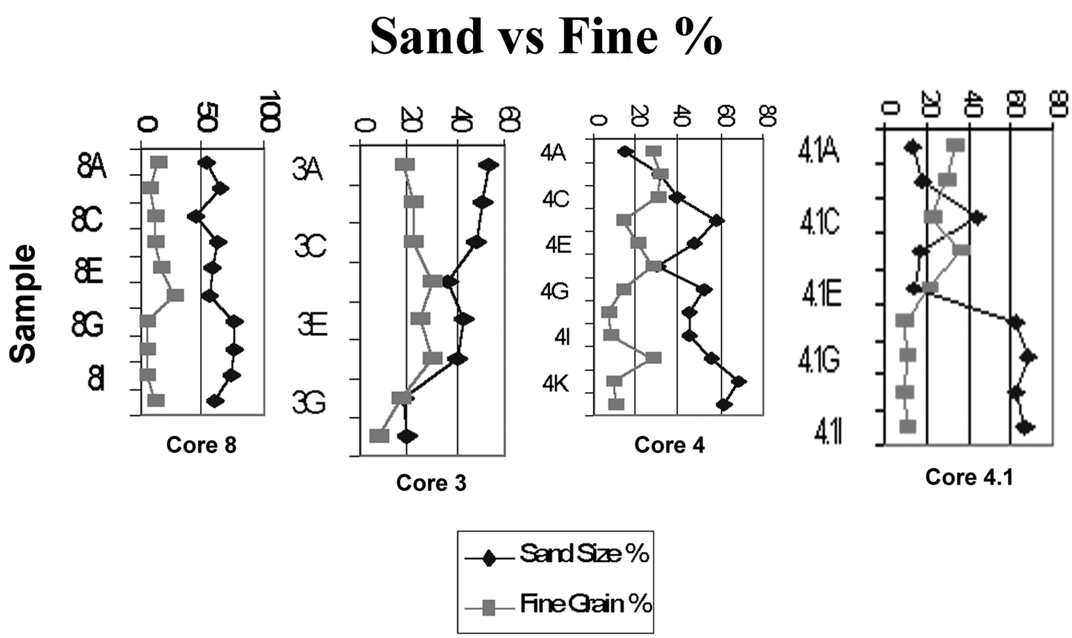

Figure 3 – These graphs represent the siliciclastic material found throughout each of the four cores. Samples A for each of the core represent the uppermost sample extracted from the cores. The upper most cores, cores 8 and 3 show a relatively steady balance between the sand size particles and those less than 62 microns. Cores 4 and 4.1 however express some variation in that there is some variance in the dominant sediment type.

rise and establish a long-term standing. The rise in sea level is indicated by a transgressive facies sequence. Core 4.1 is an exception in that it shows an early transgression/regression package followed by the transgression recorded in the remaining core.

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