HOLOCENE GEOLOGY AND MAN
IN PINELLAS AND HILLSBOROUGH COUNTIES, FLORIDA

COMPILED BY
SAM B. UPCHURCH

Southeastern Geological Society — 1980
OFFICERS OF THE SOUTHEASTERN GEOLOGICAL SOCIETY

1980-81

Felipe A. Pontigo, President
Florida Bureau of Geology
903 W. Tennessee Street
Tallahassee, Florida 32304

Sam B. Upchurch, Vice-President
Department of Geology
University of South Florida
Tampa, Florida 33620

Thomas Kwader, Secretary-Treasurer
U.S. Geological Survey
Suite L-103, 325 John Knox Rd.
Tallahassee, Florida 32303

Susan L. Klinzing, Membership Secretary
Southwest Florida Water Management District
5060 U.S. Highway 41 South
Brooksville, Florida 33512

FRONT COVER: The map on the front cover is a portion of a map titled "A Map of the Western Coast of Florida". It was compiled in 1849, 1850 and 1851 by Gerdes. The map on the cover shows the Tampa Bay area as it appeared at the time of the Seminole Wars.
SOUTHEASTERN GEOLOGICAL SOCIETY

Guidebook No. 22

HOLOCENE GEOLOGY AND MAN

IN

PINELLAS AND HILLSBOROUGH COUNTIES, FLORIDA

1980

Published by

Southeastern Geological Society
P.O. Box 1634
Tallahassee, Florida 32302
ACKNOWLEDGEMENTS

Many people have helped in putting this guidebook and field trip together. I'd like to thank all who have helped. Special thanks go to the Pinellas County Board of County Commissioners and Grant R. Bieling, Artificial Reef Supervisor, for the use of the MV TORTUGA. Without their cooperation and support this trip would not have been possible. Andrew Nicholson, Oceanographic Engineer for the City of Clearwater, volunteered much time. Sherwood Gagliano and Albert Goodyear came long distances to make this a memorable trip. Mark Nuckels did much of the leg work. Thanks to you all!

MEETING PARTICIPANTS

The following are the speakers at our Business Meeting and field trip leaders:

Ron Ceryak
Suwannee River Water Management District
White Springs, Florida

Marsha Chance
Archeological Consultant
Tallahassee, Florida

Richard A. Davis
Department of Geology
University of South Florida
Tampa, Florida

Sherwood M. Gagliano
Coastal Environments, Inc.
Baton Rouge, Louisiana

Steven Gluckman
Department of Anthropology
University of South Florida
Tampa, Florida

Albert Goodyear
Institute of Archeology and Anthropology
University of South Carolina
Columbia, South Carolina

Jay Haviser
Florida Bureau of Historic Sites and Properties
Tallahassee, Florida

Thomas Missimer
Missimer and Associates
Cape Coral, Florida

Andrew Nicholson
City of Clearwater
Clearwater, Florida

Sam Upchurch
Department of Geology
University of South Florida
Tampa, Florida
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgements</td>
<td>1</td>
</tr>
<tr>
<td>Meeting Participants</td>
<td>1</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>11</td>
</tr>
<tr>
<td>INTRODUCTION, by Sam B. Upchurch</td>
<td>1</td>
</tr>
<tr>
<td>DEVELOPMENT AND DYNAMICS OF CALADESI ISLAND, PINELLAS</td>
<td>2</td>
</tr>
<tr>
<td>COUNTY, FLORIDA, by Richard A. Davis, Jr.</td>
<td></td>
</tr>
<tr>
<td>THE SAFETY HARBOR AND UPPER TAMPA BAY PARK SITES, by</td>
<td>9</td>
</tr>
<tr>
<td>Stephen J. Gluckman</td>
<td></td>
</tr>
<tr>
<td>A MINERALOGICAL ANALYSIS OF RECENT BEACH SANDS OF THE</td>
<td>16</td>
</tr>
<tr>
<td>GULF COAST OF FLORIDA, by Ron Geryak</td>
<td></td>
</tr>
<tr>
<td>HOLOCENE SEA LEVEL CHANGES IN THE GULF OF MEXICO: AN</td>
<td>19</td>
</tr>
<tr>
<td>UNRESOLVED CONTROVERSY, by Thomas M. Missimer</td>
<td></td>
</tr>
<tr>
<td>TURTLECRAWL POINT: AN INUNDATED EARLY HOLOCENE ARCHEOLOGICAL</td>
<td>24</td>
</tr>
<tr>
<td>SITE ON THE WEST COAST OF FLORIDA, by Albert C. Goodyear,</td>
<td></td>
</tr>
<tr>
<td>Sam B. Upchurch and Mark J. Brooks</td>
<td></td>
</tr>
<tr>
<td>THE WETHERINGTON ISLAND SITE (8Hi473): AN ARCHAIC LITHIC</td>
<td>34</td>
</tr>
<tr>
<td>PROCUREMENT STATION, by Marsha A. Chance</td>
<td></td>
</tr>
<tr>
<td>ARCHAEOLOGICAL EXCAVATIONS AT THE WETHERINGTON RIDGE SITE,</td>
<td>43</td>
</tr>
<tr>
<td>HILLSBOROUGH COUNTY, FLORIDA, by Jay B. Haviser, Jr.</td>
<td></td>
</tr>
<tr>
<td>CHERT ORIGINS AND AVAILABILITY, PINELLAS AND HILLSBOROUGH</td>
<td>48</td>
</tr>
<tr>
<td>COUNTIES, FLORIDA, by Sam B. Upchurch</td>
<td></td>
</tr>
<tr>
<td>SELECTED BIBLIOGRAPHY ON HOLOCENE SEA-LEVEL POSITIONS</td>
<td>56</td>
</tr>
<tr>
<td>FIELD TRIP LOG -- DAY 1</td>
<td>63</td>
</tr>
<tr>
<td>LOG OF OPTIONAL DAY 1 FIELD TRIP SEGMENT</td>
<td>68</td>
</tr>
<tr>
<td>FIELD TRIP LOG -- DAY 2</td>
<td>70</td>
</tr>
</tbody>
</table>
INTRODUCTION

Sam B. Upchurch
Department of Geology
University of South Florida
Tampa, Florida 33620

This field trip is a result of approximately two years of collaborating with archeologists on Holocene climates and processes in Pinellas and Hillsborough Counties. I've discovered that geologists and archeologists have much in common and that we can profit from interaction. This trip is designed to bring scientists from both professions together in the hope that these interactions will develop.

The trip will consist of nine formal stops with several optional ones available. Our first stop will be at Clearwater Marina, where we will board the MV TORTUGA for a trip along the coast of Pinellas County. Andy Nicholson and Skip Davis will lead discussions on modern development of the barrier islands, coastal engineering problems, and origin of the barrier islands. The projected boat stops are labelled "a", "b" and "c" on the map on the opposite page. These stops include Sand Key and Clearwater Pass, Dunedin Pass, and Caladesi Island.

If the weather is bad (or if the boat is faster than we anticipate), there are three alternative stops (STOPS 1A, 1B and 1C) that allow us to see a small part of Caladesi Island, Honeymoon Island and some chert at Crystal Beach.

Stops 2 and 3 will be led by Steve Gluckman and will focus on two large sites on northwest Old Tampa Bay. These sites include ceremonial and burial mounds at Philippe Park and shell middens at the Double Branch Creek park site. We will then drive to Indian Rocks Beach where Ron Ceryak will discuss the provenance of sand on the Gulf coast and Tom Missimer will tell us about his work on Holocene sea-level positions on Marco and Sanibel Islands. Finally, we will drive to a site on Boca Ciega Bay (Stop 6) where Al Goodyear will discuss his work on a submerged Early Archaic site.

The second day will consist of three stops along the Hillsborough River. The first stop will be to examine a chert outcrop and to discuss the properties of chert and its origin. Then we will visit two more Indian sites. The first is unique in that it was a quarry site where chert was extracted and worked. Marsha Chance will tell us about her work on this site. Finally, Jay Haviser will discuss his work on a site that is now situated on a dune ridge. This site is very old has many puzzling aspects to it.

I hope that you will enjoy the trip as much as I have enjoyed working with the leaders of the trip. For your additional information there is a bibliography of references on Holocene sea levels and geology in Florida attached at the end of this guidebook.
DEVELOPMENT AND DYNAMICS OF CALADESI ISLAND, PINELLAS COUNTY, FLORIDA

Richard A. Davis, Jr.
Department of Geology
University of South Florida
Tampa, FL 33620

ABSTRACT

Caladesi Island is one of the few remaining natural barrier islands on the west coast of peninsular Florida. As such it provides an excellent example for studying the natural dynamics of a barrier system and for contrasting with adjacent highly developed barriers.

Stratigraphic data from numerous cores indicate that Caladesi Island originated from a shallow, subtidal shoal about 5,000-6,000 years B.P. As the island achieved a supratidal level, distinct environments developed with three lithofacies representing these environments; prograding beach sand, eolian barrier sand and sandy mangrove peat. Shelf sand and muddy lagoonal sand can also be distinguished.

Modern Caladesi Island represents a classic example of the drumstick barrier. It is prograding rapidly at its southern end and migrating landward on the north. This results in a pronounced change in the shoreline orientation. At the same time Dunedin Pass is eroding its northern side and migrating northward.

It would be interesting to speculate about changes in morphology that might have taken place on Clearwater Beach Island to the south if nature had been permitted to take its course.

INTRODUCTION

Caladesi Island represents a unique barrier island along the west-central Florida coast in that it has almost completely escaped the wrath of development. As a result it not only provides an excellent, limited access recreational area, but it serves as a site where this rather unusual barrier complex can be studied geologically. During the past few years there have been three M.S. theses in geology completed at U.S.F. on various aspects of the island and adjacent inlets; the stratigraphy and development of the island (Brame, 1976), beach sedimentation (Rosen, 1976), and the sedimentology of Dunedin and Hurricane Passes (Lynch-Blosse, 1977).
ORIGIN OF THE ISLAND

The stratigraphic study by Brame (1976) was conducted in order to try to establish the origin of Caladesi Island and to interpret its development through time. Using only sea level curves and stratigraphy (C\textsubscript{14} dating was unsuccessful) Brame established that the initial formation of ancestral Caladesi Island was about 5-6,000 years B.P. and was in the form of a sandy shoal located on the shallow Holocene shelf. As the shoal continued to build upward it became supratidal with muddy, lagoonal sands landward of it (Davis, et al, 1979). Evidence from the stratigraphy and present morphology suggests that an inlet was present north of the middle of the island. As mangroves colonized the intertidal flats on the landward side of the island, peats were accumulated.

At the present time we do not know the age of the initial development of the prograding beach ridges on the south side of the island. Based on historical records over the past century and on aerial photos, it appears that these ridges develop rapidly. It is possible that only a few hundred years have elapsed since this phase of island development began.

MODERN CALADESI ISLAND

The best documented and most interesting period of Caladesi Island history is the past century. Although Spanish charts of the area extend back to the 16th century, the first good map currently available dates from 1883 (Figure 1). You will notice that on this map the present Caladesi and Honeymoon Islands were one (Hog Island) at this time. The pass to the south was named Big Pass and it was! During that time this inlet was the only one between Clearwater Pass, several kilometers to the south, and the northern end of Hog Island. As a consequence it was carrying a large tidal prism between the Gulf and St. Joseph Sound.

In 1921 a hurricane breached Hog Island at the site of Hurricane Pass, separating it into Caladesi Island and Honeymoon Island (Figure 1). This caused a significant change in the tidal prism at Big Pass, later named Dunedin Pass, with considerable tidal exchange being carried by the new inlet. The opening of this inlet initiated or accelerated major changes on Caladesi Island. These changes are the northward migration of both inlets and progradation of the spits at the north end of Clearwater Beach and Caladesi Islands. In addition, Caladesi began to rotate due to rapid beach ridge accretion at the south end and landward transgression at the north (Figure 1). This rotation is in part due to Dunedin Pass being ebb dominated and Hurricane Pass being flood dominated (Lynch-Blosse and Davis, 1977).

Construction of a causeway between Clearwater and Clearwater Beach Island took place in the 1920's. This causeway restricted flow in St. Joseph Sound and therefore reduced the total tidal prism to the north and resulted in some sediment accumulation in Dunedin Pass. Hurricane Pass became the dominant conduit for tidal circulation during this time (Figure 2).
Continued migration northward of the spits and inlets resulted in the development of a classic "drumstick" island (Hayes and Kana, 1976) which according to Hayes is characteristic of mesotidal (2-4 M) coasts only (Figure 3). The drumstick island is wide at one end with numerous "cats-eye" ponds resulting from accretion of beach ridges.

In 1964 the causeway to Honeymoon Island was completed which again reduced the tidal prism in Dunedin and Hurricane Passes (Figure 2). There was little effect on Hurricane Pass but Dunedin Pass has been reduced to near closure during the past few years. There are some current efforts to dredge the inlet, however the hydraulics of the system indicate continued maintenance will be necessary to keep the inlet navigable.

TIDAL SEDIMENT BODIES

Tidal deltas typically form along microtidal (<2 M) coasts with flood deltas being most prominent due to protection from wave action. Both Hurricane and Dunedin Passes exhibit these features with the one at Hurricane being best developed. The combination of low tidal range, small tidal prism, and absence of hurricanes has caused these tidal sand bodies to be rather static in configuration for many years.

Ebb tidal deltas are typically poorly developed along microtidal coasts due to the tidal range and the reworking of sediment by wave action. A moderately good ebb delta is present at Dunedin Pass but only a vestigial one is found at Hurricane. This is partially related to littoral drift and available sediment coupled with the tidal hydraulics at each pass. Dunedin Pass is slightly ebb dominated and has a large sediment supply, whereas Hurricane Pass is flood dominated with only a modest sediment supply.

Initially the sand bodies that eventually weld onto the island in the form of beach ridges are subtidal. Shoaling due to wave action and increased sediment supply brings them to an intertidal position. During this process landward migration is taking place. Vegetation begins to colonize when supratidal elevation is achieved and then landward migration is slowed, taking place only during washover when storms occur (Davis, et al, 1979).

COASTAL PROCESSES

Waves and currents are the major processes affecting this system. Net littoral drift is to the north along both Clearwater Beach and Caladesi Islands, whereas there is a divergence of drift directions along Honeymoon Island near the middle. This is due to a combination of the variation in shoreline orientations and the topography on the inner shelf which causes waves to refract. Wave energy on the shelf is low and the inner shelf is quite shallow. This serves to dampen much of the energy.
Currently much erosion is taking place on the north side of Dunedin Pass with the ebb dominant tidal currents carrying it seaward and dumping it in the surf zone where sediment is reworked by waves and currents into arcuate sand bars. A fair amount of sediment is bypassing Dunedin Pass due to the ebb dominance and the shallow ebb delta. The combination of these phenomena is the main source of sediment to Caladesi Island at this time.

The northern third of Caladesi Island is migrating both landward and northward. Washover is common and mangrove peats are currently cropping out in the surf zone as a result of the transgression. Spit accretion due to littoral drift is occurring at the north end of the island but is slowing due to a dearth of sediment supply.

The net response of the barrier to these processes is the slow northward migration of the island and a rotation of its orientation. The latter is characterized by landward migration of the narrow, northern portion of the island while the southern end progrades seaward (Figure 1).

REFERENCES


Figure 1 - Changes in morphology of Caladesi Island and adjacent inlets and islands during the past century. Note the reference points at the north ends of Clearwater Beach Island and Caladesi Island. Hurricane Pass was generated in 1921 (from Lynch-Blosse and Davis, 1977).
Figure 2 - Changes in inlets during the past century. Primary events are (A) formation of Hurricane Pass, (B) construction of Clearwater Causeway, (C) construction of Honeymoon Causeway. Severe storms are indicated by S. Northward migration of inlet banks is solid for Dunedin Pass and dashed for Hurricane Pass (from Lynch-Blosse and Davis, 1977).
Figure 3 - Sketch of drumstick barrier model showing seaward accretion on updrift end adjacent to ebb delta and spit development on the downdrift end (after Hayes and Kana, 1976).
THE SAFETY HARBOR AND UPPER TAMPA BAY PARK SITES

Stephen J. Gluckman
Department of Anthropology
University of South Florida
Tampa, Florida 33620

ABSTRACT

Two archaeological site complexes, representing the remains of the latest prehistoric occupation of the Bay area, will be examined. The Safety Harbor site is a village with temple and burial mounds at the head of Old Tampa Bay. This village was occupied when the Spanish entered Tampa Bay.

The sites in the Upper Tampa Bay County Park are mostly linear shell middens. These represent food collecting and processing remains. The sites in the Park were probably occupied on a seasonal basis and may have been part of the subsistance and settlement system of the Safety Harbor period.

PERIOD DEFINITION

The Safety Harbor period dates from about 1500-1725 AD (Willey, 1949:488). Sites of the Safety Harbor period are centered in the Central Gulf Coast and Manatee Archaeological regions. Geographically, these regions occupy the Gulf coast from Charlotte County in the south to Taylor County in the north. The inland boundaries of the regions are not well defined. Safety Harbor period sites are known primarily along the coast.

The environment of the period was much like that of the present. The changes which have occurred are relatively minor and have not obscured the major cultural-environmental relationships of the period. The most obvious environmental relationship is the maritime orientation shown by the presence of shell middens as a typical feature of Safety Harbor period sites.

SETTLEMENT PATTERN

Our knowledge of the settlement pattern of the Safety Harbor period is skewed by a sampling bias toward the larger, more prominent sites. Consequently, almost all descriptions of the period's site types and cultural manifestations depend on research related to village sites which contain mounds.

The village sites tend to be located on bays, rivers, or along the coast. Safety Harbor period people utilized the burial mounds of earlier peoples as well as establishing their own sites (Bullen, 1978).
Single burial mounds are typical of village sites, but on occasion, two or more mounds may be found close together at the same site. All mounds were not used for burial purposes. Some of the mounds may have been domiciliary and some are definitely temple mounds. Some of the temple mounds were also used for the interment of the dead. The typical site of the period, as presently known, is a small village, or group of villages, with a burial mound.

ECONOMY

Marine resources, particularly shellfish, were a major item in the diet. The relative importance of shell fish to other food items is not known. Agriculture supplied some portion of the food, but data are lacking on the nature and intensity of their agricultural efforts.

SOCIAL ORGANIZATION

The presence of temple and burial mounds, villages with a possible shared identity, and principle villages which controlled territory indicate a relatively complex social organization. The Safety Harbor period people had a food supply which was sufficiently abundant to allow leisure time. Some part of this time was used in the construction of burial and temple mounds. Only with a social system capable of pulling together, organizing and controlling a labor force would this be possible.

DISPOSAL OF THE DEAD

Most burials of this period were placed in mounds. The typical mound is circular, conical or dome shaped, two to ten feet high and 35 to 80 feet in diameter. Occasionally, burials are found in cemeteries and in temple mounds. Instances of crescent shaped embankments of sand around one side of a mound are also known.

The typical burial disposal pattern is the secondary mound burial. Primary burials and cremation are also found.

Burial goods are fairly common. Ceramics, stone tools, and European goods are all found with burials in the mounds. Caches of deliberately "killed" vessels are found at the base of many mounds. "Killed" vessels are also found inverted over interments.

The burial disposal pattern is very similar to the preceding Weeden Island period. Following death, bones were cleaned of flesh and saved. Periodically, these remains would be collected and placed in a burial mound. Through time and a series of successive burial ceremonies, a mound could come to contain the remains of several hundred individuals.

ARTIFACT ASSEMBLAGE

Safety Harbor period ceramics are neither as well conceived or made as is the pottery of earlier and later times. The typical decoration is a combination of incision and puncturing. Stamped designs are found but make up only a small proportion of the decorated wares. Safety Harbor Incised, Pinellas Plain, and Pinellas Incised are the dominant pottery types. All show marked similarities to the earlier Weeden Island period ceramics.
Large and small stemless projectile points are typical. Medium and large stemmed points, ovate or triangular in shape, some with barbed shoulders, are also part of the stone artifact assemblage. Scrapers, blades, drills, plummetts, and an occasional ground stone celt are a smaller part of the assemblage.

Shell was used in the construction of dippers, cups, picks, and hammers. Most were made from the Busycon and are common at all of the sites. Shell beads and plummet shaped pendants of shell are not uncommon.

European goods were obtained from shipwrecks and through trade. Guns, knives, swords, axes, glass beads, clay pipes, and ornaments of various metals, including gold and silver, have been found at various sites. It appears as if European manufactured ornaments largely replaced native materials during the period and that European clay pipes completely replaced native forms.

Willey (1949:488) estimated a population of about 6,000 for the southern part of the area occupied by the Safety Harbor peoples. This figure was based on an estimation that the area contained about 72 mounds (villages) and that each village had a population of 30 persons. Estimating prehistoric populations is a notoriously inexact undertaking. Because the basis for the number of mounds and minimal village populations are not given, the validity of these estimations must be considered as open to question.

SAFETY HARBOR SITE

The Safety Harbor site (8-PI-2) is located about a mile and a half north of the town of Safety Harbor. Most of the site is contained within Phillippi Park, a county park at the head of Old Tampa Bay.

The site consists of a large temple mound which is about 20 feet high and 70 feet square. Several acres of village debris, mostly shell midden, surround the mound to the west and north. The burial mound is west of the temple mound by about 400 yards. It is about 12 feet high and 80 feet in diameter.

The burial mound was about one quarter excavated by the Smithsonian Institution in 1930. Several test excavations were also placed in the village area by the 1930 expedition.

In 1948 the Florida Park Service excavated at the site. They placed excavation units in the top of the temple mound and in the village west of the temple mound.

Over 100 interrments were recovered from the burial mound. All of the burials were of the secondary kind and appeared in the mound in no particular arrangement.
The mound was constructed of successive layers of sand. There was a cache of "killed" pottery at the mound base. European goods, which included iron axes and a silver tubular bead, were found only in association with burials in the upper strata of the mound. This is a good indication that the site was utilized from the end of the Prehistoric period into the early Historic period.

Nineteen five-by-five foot units were excavated to a depth of about five feet in the top of the temple mound during the 1948 excavations (Griffin & Bullen, 1950). These excavations revealed the mound fill was composed of shell and sand. It had been constructed in a number of contemporaneous stages. Evidence of one or more post supported structures was found. As with the burial mound, European materials were found only in the upper most portions of the tumuli.

Both sets of excavations in the village area were placed in approximately the same location, about 100-200 feet west of the temple mound. These excavations revealed about two feet of refuse deposit. Numerous garbage pits and post molds were uncovered during the excavations. No structure could be isolated from the host hole pattern. The artifacts and artifact sequence in the village were much like that found during the excavations of the two mounds. Large stemmed projectile points were found in the lower, earlier parts of the deposit. Small triangular points were found in the upper strata and European goods were restricted to the later, or upper portions, of the excavated sequence.

UPPER TAMPA BAY PARK

The Upper Tampa Bay County Park occupies a peninsula several hundred acres in size which juts into the northwest part of Tampa Bay. The eastern boundary of the park is Double Branch Creek. Mobbley Bay forms the western border. The park property was purchased through a county bond program in the late 1970's. Prior to park development, an archaeological survey to assess potential impact to archaeological sites was conducted. This survey was undertaken in two phases between the winter of 1978 and the spring of 1979 (Gluckman, Russell and Wharton, 1978).

The surveys were carried out by faculty and students from the Anthropology Dept. at the Univ. of South Fla.

The research design which guided the survey work attempted to test several hypotheses concerning the relationship between environment, subsistence and settlement patterns.

The first survey phase, utilizing a model for predicting site locations, concentrated on those environmental settings most likely to contain sites and which were also slated for development in the preliminary concept plan. Eighteen sites were found during these initial survey efforts.
Site types, locations and dating tentatively confirmed several of the hypothesis proposed in the research design. Some of the hypothesis could not be tested due to lack of data and others were modified on the basis of the survey data.

With one exception, all the sites found were shell middens. Most of the sites were found along the Bay and Double Branch Creek. Two sites were found on the edges of old sinkholes. No sites were found in the interior, pine flatwoods portion of the Park.

The sites varied in size from a discreet circular shell deposit about 12 feet in diameter found on the eastern salt flats of the peninsula to a midden which covers almost the entire southern end of the Park. Bay and creek edge sites tended to be long and narrow with irregularly shaped lobes extending inland and covered with water deposited sand. No excavations were undertaken at any of the sites, thus depth of deposit is difficult to judge.

The phase two survey examined those parts of the Park which had not been surveyed during phase one. No new sites were located during the second survey. This added confirmation to the site prediction hypothesis.

None of the sites found in the Upper Tampa Bay Park can be dated with assurance. Very few artifacts were found on the surfaces of the discovered sites. Of these few artifacts, perhaps half a dozen were sufficiently diagnostic for dating purposes. As the majority of sites returned no artifacts, the dateable material represents too small a sample for accurate dating.

The few diagnostic artifacts indicate that the Park property was occupied from the Late Archaic period (about 5,000 BC) to the Safety Harbor period (about 1500). The oldest site was found on the mud flats on the western side of the peninsula. Another site, found along the edge of an old sink hole, is also suspected of falling into the earlier end of the parks temporal sequence. Both of these sites are in locations which would have been more suitable for habitation during a lower sea level stand.

The presence of pottery at most of the sites indicates they were occupied after about 2000 BC. The few decorated potsherds found suggests that the main period of occupation was after 100 BC and probably occurred during the Safety Harbor period.

Any interpretation of the complex of sites found in the Upper Tampa Bay Park must be considered as preliminary. The surveys were designed to locate sites. Because of this, explanatory data are in short supply.
From the relatively large numbers of sites found on the peninsula, their size, the placement of the sites in locations favorable for the exploitation of maritime resources, the virtual absence of sites in the inland parts of the peninsula and the fact that almost all of the sites are shell middens, some tentative interpretations are possible.

The majority of the sites are most likely to have functioned as seasonal marine resource collecting and processing stations. Without excavation and analysis of recovered food remains it is not possible to know if shellfish were the main focus of subsistence activities. Even though the shell on the sites is found in large amounts, leaving the impression that massive numbers of shellfish were consumed, this may be an erroneous impression. Shellfish produce more shells than food. Thus, while shell fish were probably a staple in the diet, other food resources, like fish, may have provided the bulk of the food.

Based on the fact that occupation of most of the sites in the Park occurred during a time when the environment was much like it is today, it seems unlikely that there were year-round habitation sites in the Park. The peninsula is not rich in resources, but is well suited for the exploitation of the seasonally available marine resources of the Bay.

A settlement pattern based on permanent base camps or villages with outlying food collection and processing stations is one hypothesis which fits the available data. The presence of the Safety Harbor site only a short distance across the Bay holds out the possibility that this was the parent site from which people came to the peninsula to collect food.

Even though the Safety Harbor site is probably the closest large site to the Park, other sites, such as Weeden Island, an island in the Bay not too far south of the Park, could have functioned in the same manner at an earlier period. Also, the pattern of sites around the Bay holds out the possibility that this may have been the dominant settlement pattern around the Bay during a 5,000-8,000 period.

The sites discussed in this paper are very typical of the late Prehistoric period in the Bay area. While relationships have not been established with assurance, a settlement subsistence pattern involving village sites and outlying food collecting stations seems to best explain the presently known data.
REFERENCES CITED


Griffin, John W., and Bullen, R. P., 1950, The Safety Harbor Site, Pinellas County, Florida: Florida Anthropological Society, Publication No. 2

Mineralogical analysis has revealed a reworked high-rank metamorphic heavy mineral suite on the Florida West Coast beaches from Anclote Key to Marco Island. This mineralogy is similar to that supplied by the southern Appalachian Mountains and Piedmont. Four hypotheses were evaluated as possible routes of transport of the minerals to the West Coast beaches:

1. Migration of sand southward along the Florida East Coast, around the southern tip of the state, then northward along the West Coast.

2. Erosion of older beds cropping out along the West Coast, such as the Hawthorn Formation at Venice and Indian Rocks Beach.

Under this hypothesis the material would originally have been supplied to the older beds by some route that has become closed or quite obscured. For example, Puri and Vernon (1964) theorized that the Hawthorn Formation was deposited by a Miocene river delta system that extended southward along the axis of the Florida peninsula.

3. Southward extension of the Apalachicola River several hundred miles during a lower (-300 ft.) Pleistocene sea level stand, bringing Appalachian-derived sand to a position on the outer shelf. As sea level rose, the sand migrated eastward across the shelf and became stranded against the coast. Later, longshore transport produced the beaches.

4. A combination of several sources.

The mineral analysis, coupled with topographic and other considerations, make Hypothesis 3, an Apalachicola River source, most likely. However, additions from reworking of older beds also occur. For example, Hawthorn material is being eroded at Venice and Indian Rocks Beach and is presently migrating, mostly southward, from these two locations. This path is evident from a high sedimentary apatite content that decreases southward from Venice and Indian Rocks Beach (Table 1). However, stable heavy mineral influxes from the Hawthorn Formation do not obscure the general pattern of similarity to material derived from the Apalachicola River.

Rutile is the most stable of the heavy minerals present, and the percentage of rutile increases southward. This indicates that the sands become more mature to the south. Zircon does not follow north-south trends and may be a function of mean grain size of the bulk sample. Tourmaline is the third most stable heavy mineral present in abundance. The percentage of tourmaline
decreases southward, inversely proportional to rutile. Staurolite decreases in abundance southward as kyanite increases. The opaques decrease in abundance southward, while leucoxene (an alteration product of ilmenite) increases.

The principle stable heavy mineral trends persist throughout the entire 200 miles of continuous beach; and, although interruptions to the major trends, the principle trends resume once the local influence of the outcrops is left (Table 2).

Thus, consideration of the various alternative sand sources indicates that the prime source of the silicate sands lay to the north and was introduced to the outer shelf via a river located somewhere near the present Apalachicola River. From there it may have been driven eastward during a Pleistocene sea level rise.

REFERENCES CITED


ACKNOWLEDGEMENTS

Thanks to Dr. George Griffin, University of Florida, for suggesting the topic and directing the research for this paper; Dr. Anthony Randazzo for critically reviewing the manuscript; and Dr. Frank Blanchard for help in deciphering the heavy minerals.

Table 1

PERCENT APATITE ON FLORIDA GULF COAST BEACHES

<table>
<thead>
<tr>
<th>Station</th>
<th>% Apatite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Crystal Beach</td>
<td>0.14</td>
</tr>
<tr>
<td>2 Clearwater Beach Island</td>
<td>0.13</td>
</tr>
<tr>
<td>3 Indian Rocks Beach</td>
<td>3.00</td>
</tr>
<tr>
<td>4 St. Petersburg Beach</td>
<td>0.52</td>
</tr>
<tr>
<td>5 Mullet Key</td>
<td>0.13</td>
</tr>
<tr>
<td>6 Anna Maria Key</td>
<td>0.06</td>
</tr>
<tr>
<td>7 Longboat Key</td>
<td>0.03</td>
</tr>
<tr>
<td>8 Siesta Key</td>
<td>0.05</td>
</tr>
<tr>
<td>9 Venice</td>
<td>3.01</td>
</tr>
<tr>
<td>10 Manasota Key</td>
<td>1.35</td>
</tr>
<tr>
<td>11 Gasparilla Island</td>
<td>1.21</td>
</tr>
<tr>
<td>12 Boca Grande</td>
<td>0.38</td>
</tr>
<tr>
<td>13 Captiva Island</td>
<td>0.21</td>
</tr>
<tr>
<td>14 Sanibel Island</td>
<td>0.46</td>
</tr>
<tr>
<td>15 Estero Island</td>
<td>0.14</td>
</tr>
<tr>
<td>16 Little Hickory Island</td>
<td>0.04</td>
</tr>
<tr>
<td>17 Naples</td>
<td>0.01</td>
</tr>
<tr>
<td>18 Keewaydin Island</td>
<td>0.04</td>
</tr>
<tr>
<td>19 Kice Island</td>
<td>0.06</td>
</tr>
</tbody>
</table>
HOLOCENE SEA LEVEL CHANGES IN THE GULF OF MEXICO:
AN UNRESOLVED CONTROVERSY

Thomas M. Missimer
Missimer and Associates, Inc.
1031 Cape Coral Parkway
Cape Coral, Florida 33904

ABSTRACT

Studies of transgressive peat deposits in Florida Bay and radiocarbon analysis of Gulf Coast barrier islands yield conflicting eustatic sea level trends for the past 6,000 years. Scholl, Craighead, and Stuiver (1969) in their stratigraphic and radiocarbon investigations of marine mangrove peats concluded that eustatic sea level has risen continuously for the past 7,000 years, but at a slightly diminished rate in the last 1,500 years. The Scholl model assumes structural stability in south Florida. Systematic studies of beach ridge sets on southwest Florida barrier islands by Missimer (1973a, 1973b) and subsequent radiocarbon studies indicate that eustatic sea level rose to its present position about 5,000 to 6,000 years ago and has fluctuated both above and below its present position since that time. The evidence presented by both investigations appears to be valid. Therefore, alternative explanations must be evaluated, such as: 1) the sediments deposited in various coastal areas of south Florida have not subsided at an equal rate, or 2) south Florida has not been structurally stable and warping may have occurred episodically throughout Holocene time.

INTRODUCTION

Eustatic sea level fluctuations during the last 6,000 years have had a pronounced effect on the coastal geology of western Florida and the entire Gulf of Mexico. During the past 6,000 years, barrier islands were formed, estuarine areas flooded, and significant marine and freshwater peats were deposited. The history of Holocene eustatic sea levels in the Gulf of Mexico and adjacent water bodies has been studied by a number of scientists over the past 25 years. Two totally different theories have developed concerning the history of eustatic sea level, which are: 1) eustatic sea level has risen continuously for the past 7,000 years from a level 4 to 5 meters below present with no rise above the existing level, and 2) eustatic sea level rose to the present level about 6,000 years ago and has fluctuated above and below present level since that time.

CONTINUOUS RISING THEORY

The transgressive peat deposits of Florida Bay and the Ten Thousand Island areas of south Florida were studied in some detail by Scholl (1963; 1964; and 1965). Numerous cores taken through the peat deposits at Rodriguez and Crane Keys were dated by radiocarbon methods to yield the sea level curve published by Scholl, Craighead, and Stuiver in 1969. This curve shows that sea level was about 4 meters below present at about 6,000 years ago and rose continuously to the present level. About 3,000 years ago the rate
of the rise lessened from about 9.3 centimeters/100 years to about 3.3 centimeters/100 years.

The Holocene eustatic sea level curve of Scholl has been in general agreement with curves developed by other investigators in the Gulf Coast (Shepard, 1963), Holland (Jelgersma, 1961; 1966), Micronesia (Bloom, 1969), and Bermuda (Neumann, 1969).

FLUCTUATING LEVEL THEORY

Fairbridge (1961) was among the first to suggest that the rise of eustatic sea level through the Holocene has been quite irregular with numerous deviations. His original theory of fluctuations was based primarily on climatic considerations. The Fairbridge curve indicates that eustatic sea level rose to present levels about 6,000 years ago and fluctuated 1 to 2 meters above present to 3 meters below present during the last 6,000 years. Another investigator, Morner (1969; 1971), generally supported the Fairbridge concept, but suggested deviations of lesser magnitude with a level no more than 0.4 meter above present. Coleman and Smith (1964) have also accumulated evidence that sea level has risen above present levels during the last 6,000 years.

DISCUSSION

The best physical evidence of eustatic sea levels at or above the present level are radiocarbon age dates on beach ridges of some Gulf Coast barrier islands. Age dates on several barrier islands range from 3,000 to 5,000 years before present (Tanner and Hockett, 1973; Missimer, 1973a; 1973b; unpublished data). The basic question arises: "If eustatic sea level was between 3 and 5 meters lower than present 6,000 years ago, how could barrier islands have formed at present mean sea level or 2 meters above it at that time?"

The most complete history of the eustatic sea level of the Gulf of Mexico may lie in the beach ridge sets of Sanibel Island. Radiocarbon dates show that the oldest sets of ridges formed more than 4,000 years ago. By using the Bruun theory (Bruun, 1962) of coastal erosion during a rising sea level, as applied by Schwartz (1965; 1967), the beach ridge sets of Sanibel Island can be used to devise a rough eustatic sea level curve (Figure 1). Some basic assumptions are made to derive this curve: 1) deposition of beach ridges occurs primarily during a receding sea level period, 2) erosion of the shoreline occurs during a rising sea level, 3) the formation of beach ridges is not strictly storm dependent, 4) the average wave height in the Gulf of Mexico has not increased by more than 100%, 5) the truncations of the major beach ridge sets represent periods of non-deposition and erosion, and 6) the area has been relatively stable structurally through time.
REFERENCES CITED


Brunn, P., 1962, Sea-level rise as a cause of shore erosion: Jour. Waterways and Harbours Division, Am. Soc. of Civil Engineers.


Mörner, N.A., 1969, Climatic and eustatic changes during the last 15,000 years: Geol. en Mijnbouw, v. 48, no. 4, p. 389-399.


Figure 1. Sea-level curve for Sanibel Island.
TURTLECRAWL POINT: AN INUNDATED EARLY HOLOCENE ARCHEOLOGICAL SITE ON THE WEST COAST OF FLORIDA

Albert C. Goodyear
Institute of Archeology and Anthropology
University of South Carolina
Columbia, S. C. 29208

Sam B. Upchurch
Department of Geology
University of South Florida
Tampa, Florida 33620

Mark J. Brooks
Institute of Archeology and Anthropology
University of South Carolina
Columbia, S. C. 29208

ABSTRACT

Currently there is great interest in the archeology of drowned sites along the American continental shelf. It is certain that Holocene sea-level rise has inundated many early prehistoric Indian sites, providing for a distorted picture of early aboriginal settlement systems. Because of limitations in site detection and data recovery, no remains dating to the late Pleistocene and early Holocene have been found on the shelf. However, the drowned river systems of Gulf Coast Florida contain several examples of underwater sites of this early time period. This paper presents preliminary findings of geology and archeology of a dredged site dating from 9,000 - 4,000 B.P. A reconstruction of the original geological context is provided. A possible shell midden (Venus mercenaria) is present which is suspected to date toward the end of the Archaic occupation. By using interdisciplinary research strategies, much can be learned about former stratigraphic contexts and paleoenvironments of dredged sites.

INTRODUCTION

In the past few decades there has been a notable increase in interest by geologists and archeologists in the American continental shelf as it existed during the Pleistocene and the subsequent Holocene sea-level rise. Archeologists are interested in reconstructing the paleoenvironment of formerly exposed shelf areas in order to locate and study early prehistoric Indian settlements. As late Pleistocene and early Holocene sea-level curves are refined, it is becoming apparent that a significant area of land was available for occupation by the earliest aboriginal populations of North America. Archeological
sites resulting from these occupations must exist or have once existed several kilometers offshore of present day coast lines (Bullen, 1958; Goggin, 1960; Bryan, 1977; DePratter and Howard, 1977; Edwards and Merrill, 1977; Kraft, 1977; Brooks, et al., 1979; Fladmark, 1979; Ruppe, 1980).

Although submarine archeological sites dating to the late Pleistocene and early Holocene period are expected for inundated shelf zones, the recovery of archeological remains of this age have not been forthcoming (Edwards and Merrill, 1977: 33). This is not surprising given the considerable distance such sites must now be from present land, their depth undersea, and the potential for destruction by waves and for burial. In addition, if a site were found on the open shelf, the logistical and technical difficulties of excavation would be tremendous, if not impossible, given current capabilities (Bryan, 1977).

Today, nearly all examples of archeological sites exhibiting marine inundation in the Atlantic or Gulf of Mexico exist on or immediately adjacent to the contemporary coast line. Practically all of these sites possess shellfish remains and date within the past 5,000 years (Emery and Edwards, 1966; Salwen, 1962, 1967; Michie, 1973; Hemmings and Waddell, n.d.; Bullen, 1969; Holmes and Trickey, 1974; Ruppe, 1978).

The Florida Gulf Coast has been known by local archeologists and amateurs to also provide numerous examples of sites partially or completely drowned by sea-level rise. Significantly, some of the derived sites represented in spoil material from draglines and hydraulic dredging in Tampa Bay and small, nearby estuaries, have produced impressive numbers of Early Archaic and even Paleo-Indian lithic artifacts (Warren, 1964; Warren and Bullen, 1965; Karlins, 1970; Goodyear and Warren, 1972). All of these sites were offshore prior to being dredged, in some cases several hundred meters from present land. It is clear from the modern topography that these sites probably existed on the edges of then active rivers or creeks which were subsequently drowned by Holocene sea-level rise (Ruppe, 1980).

This paper describes one such site, a derived site from Boca Ciega Bay near St. Petersburg, Florida from which distinct Early Archaic (9,000 B.P.) and later preceramic Archaic (7,000 - 4,000 B.P.) lithic artifacts have been recovered. In an effort to reconstruct the original geological context of the site, we are relying on dredge and fill plans supplied by the Army Corp of Engineers and data available from subsurface geological studies done in the immediate area. A preliminary paleoenvironmental reconstruction is presented indicating that the site was in an old stream valley. The Early Archaic component was an interior campsite where probable procurement of locally available chert took place. The later preceramic occupants may have also quarried chert and may have been responsible for what appears to be a quahog (Venus mercenaria) midden. The importance of sea-level rise in altering the environmental situation of the site in the Long Bayou Valley is emphasized.
SITE LOCATION AND GEOLOGICAL CONTEXT

The site, as we have been able to physically examine it, is represented by prehistoric lithic tools and debitage, three shell tools and a single bone tool (deer metapodial) which have washed out of a spoil deposit derived from the Intracoastal Waterway. The spoil is a small artificial peninsula connected to Turtlecraw Point, now part of Pinellas County Veterans War Memorial Park. Geographically, the spoil material is located on the southern tip of the peninsula that separates Boca Ciega Bay from Long Bayou in Pinellas County, Florida. Using record drawings provided by the Corp of Engineers we have been able to determine that the site was originally located within a section of the Intracoastal Waterway channel (segment P-16) approximately 300 m in length located to the southwest of Turtlecraw Point approximately 300 m.

A Raytheon RTT-1000 portable survey system with a sub-bottom profiling and precision depth modes was used to specifically locate the site. A dense, fine sand mantle hindered acoustic bottom penetration. Less consolidated silt and fine sand that have accumulated in the Waterway since dredging was penetrated and those areas with clay containing localized reflectors were identified. These areas are buried by .3 to 1.5 m of fine sand and silt. Consequently, ground truth by diving could not be obtained. The reflectors are interpreted to be small shell middens or concentrations of large blocks of chert that are commonly found in the green clay elsewhere in the area (Strom, Upchurch, and Nuckels, 1980).

Using the combined evidence of local stratigraphic studies, sub-bottom profiling, and information about dredging depths and the sediments associated with the spoil island, it is possible to reconstruct the geological context from which the artifacts were derived.

The Hawthorn Formation (middle Miocene) is the bedrock at the site (Heath and Smith, 1954) and lies approximately 3 m below sea level at the site. The Hawthorn Formation locally contains abundant chert; small blocks of Hawthorn limestone with abundant phosphate pellets and narrow weathering rinds were found in the spoil. This indicates that the dredging operation just intersected the rock surface at the site.

Overlying the Hawthorn is a blue-green clay. This bed is a weathering residuum (Cooke and Mossom, 1929; Puris and Vernon, 1964; Strom et al., 1980; Strom et al., in prep.). The blue-green clay contains residual chert from the Hawthorn Formation. The green clay observed on the spoil island contains black chert with few diagnostic fossils. Chert casts of oysters (Ostrea normalis) typical of the Hawthorn were found, however. The majority of the chert consists of replacement of micritic limestones. Chert generally occurs in thin slabs (25 mm in thickness) with a well developed cortex. This clay with Hawthorn-derived chert was dredged up as part of the spoil island.

Overlying the clay is an undifferentiated layer of quartz sand. Much of the sand was initially deposited as part of the late Sangamonian Pamlico terrace (Heath and Smith, 1954). However, much of it has been extensively
reworked and redistributed since Pamlico time. Similar deposits in nearby 
Hillsborough County contain middle Archaic lithic artifacts. Sands repre-
sent in the spoil material contain few marine shells and can be presumed 
to be of marine, Pamlico deposits reworked by wind and by bioturbation.

Only two stratigraphic units are exposed in the spoil material. The 
lower unit is a blue-green, cherty clay and the upper is sand containing 
artifacts and shell. Coincidentally, the vertical sequence of the two units 
on the spoil island is the same as from the original underwater context. 
For this to have happened, the dredge had to remove the blue-green clay first 
followed by the aeolian and marine sands. This could only have occurred 
where the Hawthorn clay residuum was naturally exposed in the valley of the 
former stream draining what is now Long Bayou. The dredge must have first 
obtained Hawthorn residuum from the side of the old valley then moved up the 
bank contacting the site.

THE CHANGING HOLOCENE ENVIRONMENT IN THE LONG BAYOU VALLEY

It is important to realize that the former Long Bayou valley underwent 
significant environmental change from 9,000 B.P. to 4,000 B.P., the interval 
for which there is evidence of human occupation. The greatest change is 
attributable to fluctuations in sea level. A generally rising, though pro-
bably fluctuating, sea level affected the quality and locations of fresh 
water sources within the valley and at the site, and gradually turned the 
Long Bayou stream into an estuarine environment.

During the early Holocene, low sea levels resulted in depressed water 
levels in area aquifers. This caused surface water necessary for human 
existence and production of economically important biotic resources to be 
geographically restricted. Evidence for this comes from lakes and sinkholes 
in other parts of Florida. Watts (1975) has shown through pollen analysis 
of lake sediments in central Florida that between 13,000 and 4,700 B.P. 
there was a transition from an arid climate to one similar to the present. 
Other Florida lakes were dry until about 8,000 years ago (Watts, 1969, 1971). 
Additional indications of changing hydrology in Florida are relected in the 
cenotes at Warm Mineral Springs (Clausen et al., 1975) and Little Salt 
Springs (Clausen et al., 1979).

During the early Holocene, the flow of perennial streams and associated 
springs in Pinellas County would have been limited owing to reduced discharge 
from these aquifers. Discharge sites would not only have been less numerous 
than the present but would also have been at or near the shoreline, which 
was considerable distance west of the present shore. Archeological sites 
would have been located along the scattered coastal springs, now drowned, 
and along valleys where a perched surficial aquifer may have provided sus-
tained flow in streams. The Long Bayou valley is an example of a system 
where a perennial stream appears to have existed in early Holocene times. 
The clay of the Hawthorn residuum perched the surficial aquifer and allowed 
lateral flow into major valley systems, such as the Long Bayou valley. 
Only the larger valleys with expansive drainage basins would produce a 
sustained fresh water flow. The Long Bayou valley has the largest drainage 
basin in peninsular Pinellas County.
Published sea level data relevant to the Florida Gulf Coast (Brame, 1976; Missimer, 1973, 1979; Scholl, 1964; Schnabel and Goodell, 1968; Scholl et al., 1969; Coastal Environments, Inc., 1977) indicate that either the Moerner (1969) or Fairbridge (1961) curve is appropriate for the early Holocene. Generalizing from these curves, sea level was between -22 and -12 m during the early Archaic occupation of the site (ca. 9,000 B.P.). Based on present day bathymetry, this would place the shore line from 13 to 28 km west of the site. Clearly, during the Early Archaic period the site was located in the interior upland.

The position of the Gulf of Mexico during the later preceramic period occupation, (7,000 and 4,000 B.P.) is less certain. According to the Fairbridge (1961) and Moerner (1969) curves, sea level fluctuated considerably but had a mean position close to its present level. Accordingly, the site at this time was probably coastal. Some of the numerous Venus mercenaria shells observable in the shelly sand may reflect shellfish procurement. It is not certain that the quahog shells are a result of prehistoric clam utilization, but many of the shells are broken. Dredging may have fractured them, but they are robust shells and have resisted breakage in other areas during dredging. This same species of clam can be found living in Long Bayou today. If truly a midden, the clam shells indicate a marine environment has been present in the Long Bayou system since 4,000 B.P. or earlier.

ARTIFACT ASSEMBLAGE

Lithic artifacts were first noticed washing out from the spoil material in 1963, shortly after dredging. The artifacts were collected during sporadic visits to the fill over the last 17 years. The most common artifacts are chert flakes from core reduction and tool manufacture. Two columella shell gouges and a possible blank for a third, plus a single distal portion of a dagger-shaped tool made from a deer metapodial, constitute the only non-lithic artifacts. No pottery has ever been observed by us from the site, a finding consistent with the early lithic artifacts. Lithic procurement and tool manufacture was definitely a site activity. This conclusion is based on the fact that Hawthorn chert nodules were available plus the fact that some of the tools and flakes have been lithologically identified as being of this material. Most of the chert nodules brought up by the dredge do not exhibit chipping scars from flintknapping.

Based on temporally diagnostic artifacts, the site was used during the Early Archaic period (ca. 9,000 B.P.) and again during one or more later preceramic Archaic periods (ca. 7,000 - 4,000 B.P.).

The Early Archaic period is indicated by distinctive points and uniface tools. Specifically, a total of 4 Bolen Beveled and 2 Greenbrier points have been found. These probably date to about 9,000 B.P. in Florida (Bullen, 1975: 52-53). A number of uniface tools are present including Clear Fork Gouges (2), hafted spokeshaves with graver spurs (1), scrapers made on flakes (10), and denticulates (3). One bifacially flaked adze has been found which is similar in morphology to the Early Archaic Dalton adze (cf. Morse and Goodyear, 1973).
Other preceramic Archaic occupations are indicated by stemmed points that probably refer to the Middle and Late Archaic periods of Florida. These point styles include Florida Morrow Mountain (1), Newman (1), and Florida Stemmed Archaic (2). The manufacture of these types is expected to span the interval of 7,000 to 4,000 B.P. (Bullen, 1975). Although it cannot be determined from simply their forms, the shell gouges and the deer bone tool probably date to the later Archaic occupation, since their preservation may have been enhanced by the probable shell midden and inundation by sea level at that time. Similar shell and bone implements are common in the terrestrial shell middens of Florida.

Other temporally non-diagnostic artifacts include broken cores, broken bifaces, and various debitage forms. With current knowledge it is difficult to relate these to a specific time period.

Tools and flakes from the site have been lithologically compared to known outcrops of cherts in the Hillsborough and Pinellas County area. The majority of tools and flakes represent cherts foreign to the site. A smaller proportion of the specimens are made from local Hawthorn chert. This finding is significant on two counts. First, it indicates that the local Hawthorn chert was not extensively utilized, though presumably available. Second, a large proportion of the Archaic tools were being transported through the settlement system, probably as a function of mobility strategies related to hunting and gathering.

CONCLUSIONS

We have briefly indicated that considerable research potential exists for studying inundated Late Pleistocene and Early Holocene archeological sites which have been dredged up from their original locations. Although it has not been possible thus far to examine these remains in situ, it is clear that much of the original stratigraphic context can be reconstructed using available geological information. By examining extant geological and palynological data, in conjunction with sea level curves, it is possible to reconstruct some of the important aspects of environmental change that affected prehistoric populations during the Holocene. To our knowledge, this is the first attempt to reconstruct the stratigraphic context of an Early Holocene dredged site using geological data.

Our findings at Turtlecrawl Point are instructive for purposes of studying Early Holocene aboriginal settlement patterns. Archeologists have noted that severe distortions may result if only observable terrestrial sites are used in modeling "complete" settlement systems. Many sites representing different settlement-subsistence functions are no doubt inaccessible under the sea or have been destroyed during sea level rise.

Regarding different settlement functions, the site at Turtlecrawl Point underwent vast environmental change over a 7,000 year period. During the Early Archaic the site was situated in an interior upland environment probably associated with a perennially flowing fresh water stream. Subsequent sea level rise brought about the establishment of a
marine-influenced environment, providing a change in available subsistence resources. The exploitation of shellfish is specifically suggested by the possible clam shell midden.

Because of the low energy coastline of the Florida Gulf Coast, in this case the Tampa Bay region, there is considerable potential for the discovery of in situ, drowned Paleo-Indian and Early Archaic sites. The site deposited on Turtlecrawl Point is only one of several that are known and could be profitably studied. The lithic artifacts from Turtlecrawl Point and from other dredged sites nearby exhibit sharp edges, indicating they have not been tumbled and smoothed by the surf. This further suggests the presence of in situ deposits.

From the foregoing discussion, therefore, it is suggested that sea level rise within the river valleys of Tampa Bay may have only covered early Indian sites and not destroyed them. In addition, the artifact density is high enough at the dredged sites to indicate that detection would be possible through submarine testing techniques. Finally owing to the generally shallow nature of Tampa Bay, perhaps such sites could be excavated using controlled archeological methods.
REFERENCES CITED


THE WETHERINGTON ISLAND SITE (8Hi473):
AN ARCHAIC LITHIC PROCUREMENT STATION

Marsha A. Chance
Archaeological Consultant
542 East Park Avenue
Tallahassee, Florida 32301

INTRODUCTION

As a result of the impending construction of a Tampa I-75 Bypass by the Florida Department of Transportation, the Wetherington Island archaeological site (8Hi473), was subjected to preliminary evaluation excavations in October, 1979. The study was conducted under the auspices of the Bureau of Historic Sites and Properties of the State Division of Archives, History, and Records Management. Situated on Cowhouse Slough which forms a drainage area for the Hillsborough River, Wetherington Island is a lithic procurement site where the aboriginal population obtained material suitable for tool manufacture. The chert and agatized coral components of Florida's Miocene Tampa Formation were readily available there, apparently due to the erosion of an unusual geological uplift within the flood zone of the slough. Artifacts recovered have included unaltered material in various sizes, as well as lithic debris from the early and middle phases of tool production. Preforms and the projectile points which they preceded were not present in the assemblage, although analysis indicates that it includes a substantial number of chert and coral flakes which appear to have been utilized. Replicative experimentation has indicated that they were probably used for scraping medium-hard materials. It may be that the site had a secondary function, serving as a source for plant material as well as lithics.

Because of its geographical and technological relationship to surrounding sites, it is believed that site 8Hi473 was utilized during the Late to Middle Archaic period, between 4,000 and 6,000 years ago. As a result of the predicted intersite relationships and because it is a lithic procurement site, Wetherington Island represents an aspect of Florida's cultural prehistory which has received minimal attention, although similar sites may exist. Geologically, the site is significant because major studies of similar lithic resources have not previously been undertaken in Florida. The environmental, technological, functional, spatial and temporal aspects
of the site all warrant continued study, therefore, the site has been deemed eligible for nomination to the National Register of Historic Places, under the criteria established in the Code of Federal Regulations. A Phase III excavation has been recommended, and hypotheses have been formulated for further testing. In addition, Dr. S. B. Upchurch of the University of South Florida, has received a grant from the Florida Board of Regents to conduct an extensive petrological analysis of cherts from 8H1473 and other sites.

THE ARCHAIC PERIOD

The Archaic period, which dates from around 7,000 to 2,000 B.C., is now ordinarily subdivided into Early, Middle, and Late manifestations. Populations during the Archaic were perhaps less nomadic and more dependent upon seasonal usage and occupation of specific sites than earlier people had been, and their tools and lithic production methods varied as well. Innumerable Archaic sites are scattered throughout the Florida peninsula, and the Central Gulf Coastal Region is no exception. Most of these sites are unfortunately difficult to interpret due to a paucity of cultural material and archaeological features, with the exception of lithic artifacts. Until recently, dating procedures for these sites have depended upon the presence or absence of diagnostic Projectile Points and ceramics, with the latter marking the end of the Archaic and the initiation of a more sedentary, socially organized cultural system. However, it is significant to point out that our complete understanding of the Archaic period in Florida has been severely limited because the organic site components have been destroyed by the high acidity of Florida sands. In contrast, archaeologists are afforded increased interpretive ability in the excavation of sites from later periods because the organic deposits and artifacts are still available for observation.

The archaeological interpretation of the Archaic period is also characterized by a dearth of petrological research. In Florida, Archaic lithic tools were constructed primarily from chert and agatized coral because they were an available environmental resource well-suited to the purpose. Since these tools and the debitage resulting from their production form the entire artifact assemblage in the majority of Archaic sites, it is imperative that petrological studies be increased so that intersite and intrasite relationships can be established. The inland Archaic sites
of west central Florida are mainly lithic scatters which seem to have been left behind as the people left one resource in search of another. Surface indications range from the presence of one or two chert flakes to scatters of debitage and tools extending over very large horizontal areas. Subsurface testing has shown that in some cases lithic scatters also extend vertically to depths of over two meters below surface.

In west central Florida in general, and in the sites which lie in the I-75 right-of-way in particular, Newnan's Lake projectile points seem to be predominant. The type has been found in association with burials dated at 3,400 B.C., thus the implication is that sites in the Hillsborough Watershed probably originated between 5,000 and 6,000 years before present. Judging from the number of sites present, it may be assumed that the upper reaches of the Hillsborough River were popularly exploited. Obviously, the river and its tributaries provided fresh water and a high protein food source, as well as transportation. Significantly however, examination of the riverine topography also reveals a pattern of well-drained elevated areas interrupted by navigable bodies of water. The insular land form which supports site 8Hi473, as it now appears between the Hillsborough River and Cowhouse Slough, seems to be no less than one great site, with lithic concentrations scattered throughout. Some transitional usage also occurred on this "island", as indicated by the presence of a minimal collection of ceramics which date from succeeding cultures.

SITE DESCRIPTION

Site 8Hi473 is bordered on the south by the creek, on the east and north by seasonal ponds, and on the west by a ditched drainage area. During times of flood, the erosional remnant is surrounded by flowing water. To the north, an extension of the site lies on the slope between the pond and an upland deep sand site approximately a quarter of a mile distant.

The site is underlain by limestone of the Tampa Formation, deposited during the early Miocene age. Over the limestone a process of weathering has induced the formation of insoluble clay cap or erosional remnant within the original boundaries of Cowhouse Slough which contains discrete chert inclusions formed within the limestone by a process of ground water percolation. As silicon-rich sea waters percolated downward, portions of the limestone substrata were dissolved and replaced by chalcedony, thereby
constructing a very durable form of chert. Most of the chert at Wetherington Island was apparently precipitated along the bedding planes, and is therefore layered between limestone strata.

The clay stratum at the site is a highly plastic formation which is assumed to predate human exploitation. The upper levels of the B horizon are oxidized to a light or dark brown color, while the lower levels are yellow-gray clay. At between fifty and one hundred centimeters below the surface of the clay there is evidence of limestone deterioration to marl, precedent to the formation of the clay overburden. The clay is overlain by a single stratum of Bradenton fine sand ranging from twenty to thirty centimeters in thickness.

Limestone and chert nodules occur in abundance on the south end of the clay knoll adjacent to the creek, although interpretation is complicated by the placement of dredge spoil on the creek bank. It is apparent however, that quantities of chert may have been exposed on the erosional remnant prior to the accumulation of the sandy upper strata.

The chert of site 8Hi473 is a sedimentary rock characterized by a dense cryptocrystalline structure, and composed of chalcedony (microscryalline fibrous silica and microfibrous amorphous silica or opal), and cryptocrystalline quartz. Microscopically, it appears fine-grained and exhibits an interlocking structure of equant quartz grains and radiating chalcedony fibers. Some of the artifacts recovered from the B horizon at 8Hi473 appear to be porcelanite, but there are no comparable specimens from sand proveniences. It therefore may be that porcelanization is a function of environmental and temporal variables, as well as impure inclusions.

There is frequent reference to "the chert problem" in geological literature. This problem, as it applies to site 8Hi473, is multiple. For example, the lithic assemblage is dominated by chert which is extremely weathered or patinated on the exterior surfaces. This "rind" is characterized by roughness and albification comparable to limestone. Chemical tests indicate however, that it is in fact silaceous, does not react with acid, and therefore that this "cortex" is actually a thick layer of patination. It is texturally quite divergent from patination previously described. It is speculated that it occurred as a result of silica replacement by opal, but no studies have been conducted toward the mineralogical interpretation of patination processes. In addition, the interior colorations of the chert range widely. Chert colors are known to represent mineral
content, but the mineral content and colors are also affected by age and patination variables. Thus, "the chert problem", as it applies to the cultural interpretation of the Wetherington Island site, is one of variability. The causes of patination are not specifically understood, though they can be enumerated (temporal, environmental, and mineralogical), and the mineral content varies widely even within an individual outcrop. The interpretive value of the lithic assemblage from site 8Hi473 is therefore limited by insufficient petrological research.

A second silaceous material is also evident in the artifact assemblage. Fossilized coral was formed as silica replaced the structure of coral heads within the Tampa Formation. Culturally altered corals appeared at site 8Hi473 primarily in one specific area of excavation. The assemblage from unit 98S/40E contained pressure flaked coral and coral debitage which had been thermally altered, three qualities which were not evident elsewhere on the site. The coral may have had a separate point of origin, and it may represent a separate temporal interval as well, thus rendering unit 98S/40E anomalous in terms of spatial and functional variables.

On the basis of vegetation and disturbance patterns, the erosional remnant was initially stratified into three sub-areas to be subjected to formal excavation techniques. Excavation indicated that lithic material is multitudinous in stratum C (near the creek), occurs in less volume in stratum A (near the north pond), and is limited in stratum B (near the center of the knoll), which has been severely altered by agricultural activity. A fourth section of the site, stratum D, is located on the north side of the north pond. This area was tested but has not been subjected to formal excavation. It differs from the erosional clay remnant in terms of soil type, artifact deposition, lithic classification, and lithic volume. In stratum D the cultural material is scattered through a thick subsurface horizon of yellow sand, and the artifact assemblage includes an assortment of small debris categories associated with later stages on the continuum of lithic reduction. At fifty to seventy centimeters below surface red clay or dark sandy muck was encountered. The assemblages from strata A, B, and C, in contrast to that of stratum D, incorporated large quantities of unaltered resource material as well as a wide range of altered lithic debris produced during the early and middle stages of lithic reduction. Evidence of utilized edges occurred in the assemblages from all four strata.
LITHIC REDUCTION

Lithic technology has been defined by Collins (1975) as a system in which raw material is extracted from the physical environment and subsequently modified by specific techniques to produce a sequence of product groups. The presence or absence of various product groups within the artifact assemblage is indicative of the functional limitations of the site. During each of the stages in the lithic reduction process, certain forms (product groups) are produced and discarded or saved for future use. Collins has generated an etic model for the tool reduction process, which allows the archaeologist to make inferences regarding emic site function. The model required some modification and expansion for application to site 8Hi473, but the seven manufacturing stages and the product groups which result have been employed for this project. The stages are:

I. Acquisition of raw material
II. Core preparation and reduction
III. Primary trimming
IV. Secondary trimming
V. Modification or refurbishment
VI. Use
VII. Disposal

In an attempt to reconstruct the cultural activity pattern at Wethertong Island, the assemblage was further classified by a system of discrete attributes which relate to stages I through VII. The system was devised by members of the Division of Archives, History and Records Management staff, on the basis of lithic analytical categories discussed in archaeological literature.

HYPOTHESES AND TEST IMPLICATIONS

It appears that site 8Hi473 functioned primarily as a lithic procurement station where workable material was sought, tested, blocked, and then apparently removed from the erosional remnant to other sites where finished tools were produced. It is predicted that complete site excavation would yield some examples of diagnostic tools, but it appears that finishing activities were not a primary site function except in stratum D. However, the proximity of the procurement station to other lithic sites which contain projectile points from the Middle to Late Archaic
period, as well as the related location of some of the sites on the island between the river and the slough is an association considered sufficient to place site 8Hi473 and the adjacent sites tentatively within the same time frame. Thus it appears that petrological analyses of lithic material from separate site assemblages can link the procurement site with other adjacent sites which served other primary functions during the Late Archaic period.

The observations discussed above have led to the formulation of four hypotheses. They are interrelated to the degree that a solid comprehension of site definition and variability will depend upon thorough testing of each hypothesis.

**Hypothesis I. Temporal and Functional Aspects**

Strata A and C of site 8Hi473 are undisturbed areas which were utilized during the Late Archaic period, primarily for lithic procurement, with additional lithic activities occurring secondarily.

**Implications:** The lithic assemblage will include a few diagnostic tools from the Late Archaic period. Lithic product groups will primarily reflect procurement activities. Lithic analysis will reveal evidence of wear patterns which relate to secondary on-site cultural activities. Horizontal and vertical artifact placement and an absence of historic cultural material in strata A and C will indicate a lack of major disturbance since the Late Archaic period.

**Hypothesis II. Paleotopography**

The majority of the site area was an erosional remnant located within a slough which was frequently inundated and eroded, providing inhabitants of nearby sites with accessibility to lithic resources. Cultural activity occurred primarily on an eroded surface of clay and chert nodules, now obscured by a sand overburden.

**Implications:** The majority of the discarded or lost cultural material will be recovered from the prehistoric surface of the erosional remnant which is now the clay surface. In the areas of lower elevation now surrounding the erosional remnant, there will be no significant quantities of cultural material. There will be evidence of particle entrainment and debitage flow on receding slopes, to indicate turbulent inundation.
Water-worn soil grains will be evident at the interface of the clay and the sand overburden.

**Hypothesis III. Spatial and Technological Aspects**

The initial stages of the lithic reduction process occurred primarily adjacent to the creek, at the location of the major concentration of lithic material. Progressively later stages on the reduction continuum occurred primarily northward over the site, in correspondence to a progressively reduced concentration of resource material. The final stages of lithic reduction, including thermal alteration, occurred primarily north of the pond or at other nearby sites.

**Implications:** There will be an areal variation of product groups evident in the lithic assemblage. The initial product groups, resulting from preliminary lithic reduction activities, will occur primarily in the assemblage from stratum C, adjacent to the creek. Product groups produced at the end of the lithic reduction process, as well as thermally altered material, will occur primarily in the assemblages from stratum D, on the north side of the pond, and from other nearby sites. There will be observable comparability between the major elements of chert samples taken from assemblages of site 8Hi473 and nearby sites. There will be observable comparability between the trace elements of chert samples taken from assemblages of site 8Hi473 and other nearby sites.

**Hypothesis IV. The Spatial Aspect**

The spatial distribution of the on-site lithic reduction activities at site 8Hi473 includes a pattern of lithic clusters, each produced by one or two individuals, scattered randomly over the surface of the erosional remnant.

**Implications:** Obvious clusters of lithic material will be revealed through excavation of large contiguous areas. Each cluster of lithic material will include product groups indicative of a sequence of activities within the lithic reduction continuum. The circumference of each cluster of lithic debris will correlate with the production capacity of one or two individuals.

Clearly, the cultural and petrological data available at 8Hi473 is varied and complex. Verification of the archaeological test implications will depend upon the interdisciplinary interpretation of unique variables,
and in the process, a thorough description and characterization of local cherts will be compiled. The product will be a geological data base which will serve as a continued reference in the future.

REFERENCES CITED

Archaeological Excavations at the Wetherington Ridge Site, 
Hillsborough County, Florida

Jay B. Haviser, Jr.
Fla. Division of Archives 
Bureau of Historic Sites 
Tallahassee, Florida 32301

ABSTRACT

As mitigation, prior to impact of the construction of Interstate 75 through Hillsborough County, Florida, an archaeological excavation was conducted at the Wetherington Ridge Site. What follows is a description of the research design, excavation procedures and some preliminary results from the artifactual assemblages recovered during that excavation.

GENERAL SETTING AND EXCAVATION DESIGN

The field excavation of the archaeological site (8 Hi 4.72) Wetherington Ridge, in Hillsborough County, Florida was begun in March of 1980. The work was conducted by the Florida Division of Archives, Bureau of Historic Sites, for the Department of Transportation as a part of the activities to mitigate impact of Interstate 75 Highway construction. The excavation of this site, by the author, was completed in August of 1980.

The general area of the Wetherington Ridge Site occupies approximately fifty acres, at the border of the Polk Uplands and the Gulf Coastal Plain. There are two sinkholes present at the site. The easternmost is filled with 1-3 meters of water and has diameters of 30 meters at the waterline and 100 meters at the rim. The western sinkhole is filled with 6-7 meters of water and has diameters of 80 meters at the waterline and 100 meters at the rim. Both sinkholes have silt and sand bottoms, with the eastern sinkhole having a lesser angle of slope for its sides. The highest ground of the site (20.03 meters A.M.S.L.) is to the north of the eastern sinkhole, in the northeast quadrant of the site grid. The lowest part of the site (11.71 meters A.M.S.L.) is in the southwest quadrant of the site grid.

The site has a predominately pine oak vegetation cover, with a soil group of exclusively Lakeland Fine Sand soils. Excavation revealed humic, unleached and leached sand strata comprising "A" Zone sands, with the upper two meters containing cultural material. A non-cultural "B" Zone clayey/sand, laminae stratum was noted under the "A" Zone soils, beginning at 3-3.5 meters below the surface. This stratum occurs uniformly over the site. Heavy bioturbation has been an unfortunate factor in the vertical movement of the "A" Zone sands at Wetherington Ridge.
This site was arbitrarily divided into four subareas (A, B, C and D). These four subareas were all tied together on the same 20 meter interval grid, creating a 400 x 400 meter square. All datum planes for all excavations were tied into the central grid above mean sea level (A.M.S.L.) datum. A three stage excavation plan was designed, this consisted of an initial total site coverage, at 20 meter intervals, of 50 x 50 x 160 centimeter test pits (certain man-made obstructions such as houses and asphalt roads made it impossible to dig at every 20 meter interval). There was a total of 375 of these "Stage 1" tests, dug in 20 centimeter arbitrary levels (eight levels). The results of these tests were the basis for location selection of fifty-two "Stage 2" excavations. The Stage 2 tests were 1 x 2 meters, dug in 20 centimeter levels to 240 centimeters below datum established at the ground surface at each test's southeast corner. All material was labeled and bagged according to level provenience. Features or artifact concentrations were labeled and bagged separately.

The final stage of excavation at Wetherington Ridge was to test, not only the deeper artifact concentrations, but also to try and identify activity areas smaller than at 20 meter intervals. This "Stage 3" consisted of two 3 x 3 meter excavations, dug in 10 centimeter levels to 200 centimeters below datum at each test. Both of the Stage 3 test units are located in the higher ground of the northeast quadrant of the site grid.

In order to salvage other diagnostic artifacts from this site, a post-formal excavation, bulldozer investigation was conducted in areas A and B. With a frontend-loader, strips of 10-20 centimeters, 3-4 meters wide, were scraped while a crew followed and provenienced any diagnostic artifacts or concentrations uncovered. It was determined that no further formal stratified recovery would be conducted, therefore leading to a decision to use the bulldozer prior to the site being destroyed.

GENERAL RESEARCH DESIGN

The major purpose for excavation of the Wetherington Ridge Site was as a salvage of artifactual assemblages prior to highway construction. However, to better develop the archaeology of Hillsborough County and contribute to the universal archaeological data bank, certain problems have been selected to try to solve. For this site, two basic levels of questioning are being dealt with, almost an emic and etic, if you will.

The first problem involves the understanding of Wetherington Ridge as a site; What type of site was it? Who occupied it? How long was it occupied? and What relationship does it have with other sites associated either geographically or culturally? This being more of a general, emic, line of questioning.

The second area of research is the investigation of the environmental effects on the artifacts that represent Wetherington Ridge. By far, the most prolific artifact group from this site was chert debitage. This second research orientation is directed toward the cause and effect of patination of chert artifacts, by examining both horizontal as well as vertical distribution of chert patination.
The first, more general problems to be solved are dealt with by looking at the artifacts from Wetherington Ridge as one unit. The type of site will be determined by analysis of the assemblage and recognition of tools and tool types. From recognition of tools, tool use can be inferred and thus a predominance of certain tool types at the site will make for the inference of site use (i.e., maintenance tools such as drills and scrapers are found in more abundance at a base camp or area of primary habitation, whereas task tools such as projectile points are carried off to exploit the natural resources and found more frequently at work camps or short-term hunting camps (Binford and Binford, 1969)).

By whom and for how long Wetherington Ridge was occupied will be determined by an examination of the tool types and ceramic types found at the site. From previous archaeological research in this area, certain cultural groups have been identified based on similarities of artifact modal classifications. Therefore, a particular artifact assemblage, projectile point shape or ceramic tempering can have distinctive cultural identities. These cultural classifications have been strapped onto a skeleton of archaeological artifact clusterings, which may or may not always be differing cultural groups, but do always represent chronologically and/or geographically changing manifestations. In an effort to more precisely date these cultural/artifactual assemblages, an absolute dating technique called thermoluminescence will be applied to selected thermally-altered chert artifacts from different vertical and horizontal positions at Wetherington Ridge.

To approach the second level of research at the site, two phases of investigation will be applied. The first phase is a look into the horizontal distribution of chert patination occurrence, with particular interest in the soil formation processes distinctive of different regions in North America. To carry this out, I have designed a "Chert Patination Questionnaire" which has been sent to over two hundred locations in North America. The questions are short and uncomplicated so that the return of a majority of the forms is expected. The second phase of this patination research involves visual inspection of all chert artifacts recovered from the site to determine what percentages have no patination, partial surface patination or complete surface patination. A comparison will then be made of each percentage in relationship to the vertical distribution of the artifacts in the stratified excavations. Supplementary to this will be a cross-section analysis of cherts at varying vertical positions to determine the amount of patination of the bulk material (i.e. thickness of patination). Patination is the weathering of cherts. The Wetherington Ridge Site offers an ability to standardize some of the major environmental effects, particularly soil and water. This site is entirely within the Lakeland Fine Sand soil group, the soil samples taken from each level of the Stage 2 tests will enable me to standardize soil texture, color, pH and proximity to water table or surface. The effect of water can be standardized as to present and past annual rainfall, piezometric level and oxygen content of local waters. It is hoped that a chemical content analysis can be done of the patina and bulk material. The principle tests required would be for \( \% \text{SiO}_2 \), \( \% \text{Fe} \), \( \% \text{Al} \), and \( \% \text{SiO}_2 \cdot \text{nH}_2\text{O} \) (opal).
DISCUSSION

The co-operative move toward an interdisciplinary approach among the sciences has been increasing rapidly since the early 1960's. The need for an exchange of data and ideas between geology and archaeology is an obvious one. Although quite frequently, geologists express that the archaeologists attempt to be too time specific, and likewise the archaeological community complains of the great chronological generalities viewed by geologists. In reality, we both are saying that general and specific perspectives are required to adequately assess past cultural and natural history. As an archaeologist, I have tried to investigate the specific characteristics of the cultural development at Wetherington Ridge, as well as the specific natural patination process occurring there, while being receptive to the more general framework of the Late Pleistocene/Holocene age of the site.

As pointed out earlier, the field portion of this site has only recently been completed. Therefore, a thorough analysis of the artifacts recovered has only just begun. For the purposes of this paper, I have relied on my field notes and observations during excavation to construct a probable cultural sequence for Wetherington Ridge, again I must point out that this is only a preliminary determination which must be verified or modified by further analysis.

Because of the more precise nature of the analysis, the patination research for Wetherington Ridge will not be discussed in this paper.

RESULTS

There appears to have been a very long occupation at the Wetherington Ridge Site. Although no Paleo-Indian (pre-10,000 B.P.) material was excavated at the site, several Clovis projectile points were noted in local personal collections. These were reported as having come from the site area.

The first cultural period recognized at the site is of the Early Archaic (10,000-8,000 B.P.). This period is evidenced by a Dalton projectile point, Stanfield points and a variety of plano-convex scrapers, basally expanded drills and crescent shaped scrapers (Griffin, 1978).

The Middle and Late Archaic (8,000-3,000 B.P.) were heavily represented at the site with Newman, Culbreath, Westo and Florida Stemmed projectile points. Also noted were several biface and uniface scrapers, drills, knives and burins. This artifact assemblage is attributed to part of the Middle and Late Archaic (Bullen, 1975).

What has been called the Transitional period, between Archaic and Ceramic periods, has a rough equivalence with the transition from Meso-Indian to Neo-Indian technological and cultural levels. At Wetherington Ridge several Hernando projectile points were located which are indicative of this period (Bullen, 1975). Another attribute of the Transition period is fiber-tempered pottery, which did not appear at this site.
After the Transitional period came the Ceramic periods. Previous archaeological studies in Florida indicate that agriculture and larger, more sedentary populations were developing at this stage. At Wetherington Ridge there were four varieties of aboriginal ceramics based on tempering. These represent four cultural periods at the site. A sand-tempered ceramic associated with the Deptford cultural group (2500-2000 B.P.) and a limestone-tempered pottery determined as part of the Pasco Series, which is as yet not well defined but generally placed after Deptford, were recovered for the site. A non-tempered ceramic, made of Fullers earth clay, associated with the St. Johns group (1700-800 B.P.) was found as was a variant of sand-tempered pottery indicative of the Safety Harbour period (800-400 B.P.). A projectile point called Pinellas, which represents this latest ceramic period (Bullen, 1975) was also located.

In conclusion, there has been a very long occupation at this site, beginning at least 8,000 years ago and continuing, either seasonally or possibly more permanently, until historic contact. The wide variety of particularly maintenance tools seems more indicative of a base camp type settlement.

The laboratory analysis of this material is presently ongoing and a more complete understanding about the site will have been reached when it comes time for the final report. It is hoped that this report of the Wetherington Ridge Site will be a valuable contribution not only to the archaeological community but also to the researchers of patination and silicates in the field of geology.

REFERENCES CITED


CHERT ORIGINS AND AVAILABILITY,
PINELLAS AND HILLSBOROUGH
COUNTIES, FLORIDA

Sam B. Upchurch
Department of Geology
University of South Florida
Tampa, Florida 33620

ABSTRACT

Chert occurs in several forms in the Tampa Bay area. Most common is replacement of limestones with poor to moderate preservation of original rock fabric. Void-filling chalcedony is locally common and includes the well-known Tampa Bay geodes and fillings of smaller fossil molds, solution channels and breccia porosities. One locality is known where true porcelanites, which are composed of mixtures of opal-CT and palygorskite, can be found. Early man utilized all of these materials and apparently concentrated near outcrops where they could be found. Most of the outcrops studied to date appear to be related to topographic highs formed by differential erosion of the more resistant cherty strata.

INTRODUCTION

Early man utilized many materials for every day life. In Florida the climate renders most of those materials unstable and, therefore, ancient remains rarely contain evidence of these materials. For example, early man in Florida undoubtedly used wood. In most archeological sites, wood is rare or absent because it has been oxidized. One of the most stable materials used by early man was chert, which is ubiquitous in early man sites in Florida. Chert is not inert and undergoes destruction, but the rate of destruction is sufficiently low that chert remains long after other, less durable materials are destroyed.

Thus, chert has become a material of concern to both geologists from the standpoint of origin and diagenesis and archeologists from the viewpoint of information on lifestyle, provenance, and age. A group of geologists at the University of South Florida is involved in a study of the provenance of cherts used by early man and the diagenesis those cherts undergo. This has led us to study the origins of chert in the first place and the resulting petrofabrics, chemical and mineralogical compositions and fossil content.

This paper briefly discusses some of the preliminary findings we have made and indicates the nature of research now underway. Geologists involved in the study at the present time include Richard N. Strom, Abraham Rosenzweig, Mark C. Nuckels, and myself.
LOCATION OF STUDY

To date the majority of our study has been concentrated in the immediate vicinity of Hillsborough and Pinellas Counties, Florida (Fig. 1). This is not just because of the obvious logistic benefits. The area within the drainage basin of the Hillsborough River is known to be an important chert-producing area in the state and a wide variety of chert types can be found within a relatively small area. Several of the best known chert sites are now well exposed because of construction and several will be lost to further study upon completion of the construction. For example, the most famous site in Florida is the locality at Ballast Point (Fig. 1). This locality is poorly exposed at the present time because of development and filling operations on the coast of Hillsborough Bay. Last year, however, a major sewerage construction project in the area created important exposures for short periods of time. The proposed I-75 corridor east of Tampa crosses over another famous site, the Cow House Creek site. Thus, we have felt it important to concentrate on the Tampa Bay area.

The sites thusfar selected are identified on Figure 1. Each is briefly summarized in Table 1. Note that over half of the sites under study are associated with Indian sites where evidence of quarrying and preparing chert for tool manufacture is present.

ORIGIN OF CHERTS

There are several theories as to the origin of chert in general and specifically Florida cherts. The models for the origin of Florida cherts can be grouped into three major categories: maturation from diatomaceous or volcanogenic deposits, precipitation of weathering products and precipitation from silica-rich fluids derived from surficial, alkaline lakes.

Wise and Weaver (1974) and Weaver and Wise (1974) have shown compelling evidence for formation of cherts in north Florida from destruction of opaline material, such as diatom frustules. Carver (1980) shows examples of sponge spicules that may have been sources for silicification. Gremillion (1965) has argued that the opal-CT reported in the Miocene of north Florida is a result of alteration of volcanic ash.

Cooke (1945) and others have argued that the silicification in the Tampa Bay area is a result of alteration of clays. Cooke (1945, p. 125) states that "On weathering the limestone breaks down into greenish clay and the fossils become silicified." The limestone itself is not a source of silica, only clays contained in the limestone could provide silica for silicification of fossils. Altschuler et al. (1963) described a sequence of alteration of montmorillonite to kaolinite in which silica could be released to ground waters. They proposed that cherts in the Miocene of Florida could have formed from these solutions.

Finally, Strom et al. (1980), Upchurch et al. (1980) and Strom et al. (in press) have shown evidence from the cherts of the Tampa Bay region that indicates that there was a period of intense weathering in late Miocene. This period was characterized by formation of alkaline lakes in which synaeresis of palygorskite muds was accompanied by saturation with opal-CT in some cases and "case hardening" with rims of opal-CT in others. At the same time, they argue, solution channels, terra rossa soils, solution breccias, and silcretes and calcretes were forming. Silicification of these features suggests that they were penecontemporaneous.
CHERT TYPES

There is a great diversity of chert types in the Tampa Bay area. In this paper chert is defined in a very loose sense to include all forms of silicification of sedimentary rock. Most of the silicified rocks are simple replacements of limestones by microcrystalline quartz. However, opal-CT (opaline silica with disordered α-cristobalite and α-tridymite structure) and chalcedonic quartz are also widespread. We have recognized the following chert types in the field trip area:

Replacement chert. Replacement of limestones is most widespread and can be found associated with the St. Marks Formation (Tampa Formation), Suwannee Formation and, to some degree, Hawthorn Formation. The replacement cherts are usually associated with the present-day erosion surface and are frequently blanketed with the green, cohesive, montmorillonitic clays that will be seen at the Cow House Creek stop. These are the clays that Cooke (1945) referred to and that have been called the "silex beds" at Ballast Point. The replacement cherts are frequently associated with terra rossa soil remnants and are in breccias. These breccias are interesting in that either the fragments or martix or both may be replaced. Chert also occurs in porous rims around solution channels and joint surfaces. Most of the cherts, including those sought after for making tools by the Indians, are simply fine grained, fossiliferous replacements of massive limestone.

Void-filling chert. The well-known Tampa Bay geodes are good examples of this type of chert. The original space that has been filled with chaledony can have several origins. The Tampa Bay geode-type material was fossil molds. Other spaces include synaeresis cracks, pore space in breccias, burrows and borings, and primary porosity. An unique type of void-filling was found in western Pasco County several years ago. This material consisted of pseudomorphs of selenite (gypsum) crystals. The void-filling material is primarily fibrous quartz (chalcedony). Other void filling materials include opal-CT, microcrystalline quartz, barite, and calcite (Strom et al., in press).

Box-work geodes and porcelanites. Two unique suites of rocks were found in the spoils from the harbor-deepening project in Hillsborough Bay. These rocks are related to the alkaline lakes described above. Box-work geodes consist of irregular, interconnected sheets of void-filling chaledony. The chaledony sheets are filling synaeresis cracks. The clay which underwent synaeresis is almost pure palygorskite. Associated with the box-work geodes are similar rocks with synaeresis cracks and chaledonic void fillings. The clay matrix, however, is a mixture of palygorskite and opal-CT. These rocks, which are textbook examples of porcelainites, were used as raw materials by early man. At least one artifact that appears to be heat-treated porcelainite was found in the spoils. The box-work geodes have been described by Strom et al. (in press).

DIAGENESIS

The cherts from the Tampa Bay area have undergone several episodes of diagenesis. Those cherts that originally contained opal have at least partially undergone alteration to micromosaic quartz. In fact, the only rocks we find that still contain significant opal are the porcelainites. The other rocks show evidence of once containing opal, but are now wholly quartz.
A second form of diagenesis includes formation of tripoli rinds on weathered surfaces. These rinds are of interest to both geologists and archeologists. The geologist is concerned with the rind because of any information about past environments it may contain and because of the economic value of large deposits of tripoli. The archeologist is interested in the rind because of the information it contains about the age and post-burial history of lithic artifacts. There are two types of rinds. Those rinds that are old and well developed with large grain sizes and evidence of chemical alteration occur on naturally exposed materials and are called cortex. Note that not all cortex is a product of alteration. Some consists of partly silicaified host rock. Artifacts frequently develop these rinds as well. Artifacts are relatively young and the rind, which is called a patina, is finer grained and frequently contains liesegang banding. The banding is a result of diffusion of iron through the rock (Clark and Purdy, 1979). Our preliminary model for the formation of the patina or cortex involves a combination of chemical processes that result in an increase in chemical stability of the quartz in the chert. The major processes include grain growth, which increases stability by minimizing surface free energies, and impurity expulsion, which increases stability by reducing chemical interactions in local grain neighborhoods.

RELATION OF CHERT TO EARLY MAN

Chert was a major resource to early man. He sought out deposits that contained homogeneous materials in a form that could be easily worked. In the Tampa Bay area the best cherts from this standpoint are replacements of fine-grained limestones by microcrystalline or micromosaic (originally opaline) quartz. The cherts should be easily extractable and water saturated. Water saturation is necessary because it improves the ease with which the chert can be flaked. Heat treatment reduces the need for wet cherts. The green clay beds that overly the Miocene section in this area fill both requirements. First, the cherts are generally in relatively small blocks with little limestone matrix remaining to be cobbled off. Second, the clays keep the cherts moist. Therefore, only certain types of outcrops would be preferred.

The actual distribution of outcrops of chert-bearing strata in the area during aboriginal times cannot be predicted. Figure 1 shows most of the major outcrops at the present time. Those which were used by Indians are indicated. Note that there is a correlation of chert with the clay bed. This may or may not have been significant to the Indians (I expect it was).

With the exception of the Boca Ciega Bay site (see the paper by Goodyear, Brooks, and Upchurch in this guidebook), all of the sites known to have been available to early man occur on bedrock highs. We have interpreted these highs to have formed by differential weathering of bedrock. The cherty areas are more resistant to chemical weathering and stand up as topographic highs. Furthermore, at least three of these highs are associated with rocks that either now contain or have once contained opal. These sites appear to be locations of the alkaline lakes mentioned above. Five sites include significant replacement of Miocene corals. The corals provided porosity for void-filling chalcedony and true replacement. These topographic highs are klintar, or erosion-resistant coral mounds. We are at present trying to use these models for the origin of chert-bearing outcrops to predict other chert locations. Note that chert occurs throughout the upper portions of the bedrock in the area and appears in many areas to be controlled by karst, so our model will only predict heavy concentrations.
REFERENCES CITED

montmorillonite to kaolinite during weathering. Science, 141:148-152.

Carver, R.E., 1980. Petrology of Paleocene and Miocene opaline sediments,
southeastern Atlantic coastal plain. Jour. Sediment. Petrology,
50:569-582.


Cooke, C.W., 1945. Geology of Florida. Florida Geol. Surv., Bull. 29,
342 p.

Gremillion, L.R., 1965. The origin of attapulgite in the Miocene strata
of Florida and Georgia. Unpubl. Ph.D. Dissert., Florida State Univ.,
139 p.

Strom, R.N., Upchurch, S.B., and Nuckels, M.G., 1980. Late Miocene silicification
in central Florida. II - Cause of silicification and related genetic
events (abs.). Abstract submitted to the Miocene Symp. of the Southeastern

Strom, R.N., Upchurch, S.B., and Rosenzweig, A., in press. Paragenesis of
"box-work geodes", Tampa Bay, Florida. Submitted to Sedimentology.

Upchurch, S.B., Strom, R.N., and Nuckels, M.G., 1980. Late Miocene silicification
in central Florida. I - Petrography and genesis of siliceous rocks (abs.).
Abstract submitted to Miocene Symp. of the Southeastern United States,

Weaver, F.M., and Wise, S.W., Jr., 1974. Opaline sediments of the southeastern

Wise, S.W., Jr., and Weaver, F.M., 1974. Chertification of oceanic sediments.
In K.J. Hsu and H.C. Jenkyns (Eds.), Pelagic Sediments, Int. Assoc. of
<table>
<thead>
<tr>
<th>Location</th>
<th>Host formation</th>
<th>Rock types and fabrics</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>St. Marks</td>
<td>Replacement of limestones, much void filling</td>
<td>Many corals, silicified clay</td>
</tr>
<tr>
<td>Honeymoon Island</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CB</td>
<td>St. Marks</td>
<td>Replacement of limestones</td>
<td>Clay not obser.</td>
</tr>
<tr>
<td>Crystal Beach</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>Hawthorn</td>
<td>Replacement of limestone</td>
<td>Silicified oysters, clay</td>
</tr>
<tr>
<td>Bay Pines Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP</td>
<td>St. Marks</td>
<td>Replacement of limestones</td>
<td>Clay, probably an Indian quarry</td>
</tr>
<tr>
<td>Critus Park</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>St. Marks</td>
<td>Replacement of limestones, much void filling</td>
<td>Many corals, clay</td>
</tr>
<tr>
<td>Ballast Point</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TBU</td>
<td>St. Marks</td>
<td>Replacement of limestones, much void filling, box-work geodes, porcelanites</td>
<td>Many corals, clay</td>
</tr>
<tr>
<td>Hillsborough Bay</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH</td>
<td>St. Marks</td>
<td>Replacement of limestones</td>
<td>Many corals, clay</td>
</tr>
<tr>
<td>Rock Hammock</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAB</td>
<td>St. Marks</td>
<td>Replacement of limestones</td>
<td>Few corals, clay</td>
</tr>
<tr>
<td>Fowler Avenue Bridge</td>
<td>(Tampa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Replacement of</td>
<td>Clay,</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td>Cow House Creek, St. Marks (Tampa)</td>
<td>limestones</td>
<td>important Indian quarry</td>
<td></td>
</tr>
<tr>
<td>Tampa By-pass Canal, St. Marks (Tampa)</td>
<td>limestones, much brecciation</td>
<td>terra rossa soils, man-made outcrop</td>
<td></td>
</tr>
<tr>
<td>North Tampa By-pass Canal, St. Marks (Tampa)</td>
<td>limestones, much brecciation</td>
<td>man-made outcrop</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Location of chert outcrops included in the present study. Localities include: (1) HI, Honeymoon Island; (2) CB, Crystal Beach; (3) BP, Bay Pines Veterans Memorial Park; (4) CP, Citrus Park; (5) BB, Ballast Point; (6) TBU, Hillsborough Bay; (7) RH, Rock Hammock; (8) FAB, Fowler Avenue Bridge; (9) CHC, Cow House Creek; (10) TBC, Tampa By-pass Canal at Fowler Avenue; and (11) NTBC, North Tampa By-pass Canal at Morris Bridge Road.


Marmer, H.A. 1949. Sea level changes along the coasts of the United States in recent years. Trans. of American Geophysical Union 30 (2):201-204.


Milliman, J.D. 1971. Pleistocene geologic history. In Cultural resource survey, outer continental shelf from Cape Hatteras to Key West. Ms. in prep. for B.L.M. E.I.S. on coastal resources.


Shepard, F.P. 1956b. Late Pleistocene and recent history of the central Texas coast: Jour. Geol., v. 64, p. 56-69.


<table>
<thead>
<tr>
<th>Interval Location</th>
<th>Mileage</th>
<th>Cumulative Mileage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>Holiday Inn North (field trip headquarters), 400 E. Bearss Avenue.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Turn left</strong> on Bearss Avenue.</td>
</tr>
<tr>
<td>0.1</td>
<td>0.1</td>
<td></td>
<td><strong>Turn right</strong> on ramp to I-275 south.</td>
</tr>
<tr>
<td>4.8</td>
<td>4.9</td>
<td></td>
<td>Bridge over Hillsborough River. The water tower to the right (west) and swimming pool and pavilion to the left (east) are landmarks for which Sulphur Springs is well known. The pool is over a spring for which the community was named.</td>
</tr>
<tr>
<td>4.1</td>
<td>9.0</td>
<td></td>
<td>Continue on I-275 at junction with I-4.</td>
</tr>
<tr>
<td>1.1</td>
<td>10.1</td>
<td></td>
<td>Bridge over Hillsborough River. Before development there were several outcrops of chert in this area. These contained fossils of the St. Marks (Tampa) Formation (Heilprin, 1887) and were sources of chert tools for early Indians in the area.</td>
</tr>
<tr>
<td>4.0</td>
<td>14.1</td>
<td></td>
<td><strong>Turn right</strong> on SR 60. Move into left lanes.</td>
</tr>
<tr>
<td>1.0</td>
<td>15.1</td>
<td></td>
<td>Bear left and stay in left lane. This is Eisenhower Boulevard.</td>
</tr>
<tr>
<td>0.8</td>
<td>15.9</td>
<td></td>
<td>Bear left with SR 60 onto Courtney Campbell Causeway.</td>
</tr>
<tr>
<td>0.8</td>
<td>16.7</td>
<td></td>
<td>Old Tampa Bay, the western arm of Tampa Bay.</td>
</tr>
<tr>
<td>4.4</td>
<td>21.1</td>
<td></td>
<td>View to the right shows the location of the Double Branch Creek archaeological site (Stop ). The site is in the mangroves on the east shore of Hobbly Bay, the small embayment just east (right) of the power plant. Note that much of the coast of upper Old Tampa Bay is low-lying and consists of mangrove and salt marsh.</td>
</tr>
<tr>
<td>5.4</td>
<td>26.5</td>
<td></td>
<td>McMullen Booth Road. SR 60 is now called Gulf to Bay Boulevard. Continue straight ahead.</td>
</tr>
<tr>
<td>1.3</td>
<td>27.8</td>
<td></td>
<td>Junction of SR 60 with US 19. Continue straight ahead.</td>
</tr>
<tr>
<td>2.9</td>
<td>30.7</td>
<td></td>
<td>Bear to right following Gulf to Bay Boulevard and SR 60. Sign to Downtown Clearwater.</td>
</tr>
<tr>
<td>0.5</td>
<td>31.2</td>
<td></td>
<td>Bear left on SR 60. This is Cleveland Street. Clearwater</td>
</tr>
</tbody>
</table>
was first settled in 1841 at Fort Harrison.


Memorial Causeway. The view ahead is a dramatic example of development of Florida's barrier islands. To the right (north) is Clearwater Beach Island and the uninhabited Caladesi Island State Park. To the left is Sand Key. The high dune ridge at left rear, on the mainland, was the site of Ft. Harrison. The bay is St. Joseph Sound.

Turn left onto Fountain Drive.

Enter Clearwater Marina and park.

STOP 1. At this stop we will board boats for a trip along the coastlines of Sand Key, Clearwater Beach Island, and Caladesi Island. Andrew Nicholson and Richard Davis will discuss problems with development of the beaches (AF) and their origin (RD). See the paper by Davis for more details.

Return to bus and turn right onto Causeway Boulevard.


---------------------------------------------

NOTE: Optional field trip begins here. See the end of the first day log for this optional log.

---------------------------------------------

Bear right on SR 60 (Gulf to Bay Boulevard).

Bear left on SR 60 (Gulf to Bay Boulevard).


Turn left on McMullen Booth Road (CR 593).

Turn right on SR 590 (4th Street S.).

Sharp left bend (10th Street S.).

Turn right on Main Street. Safety Harbor was built around a group of springs that have been used by Indians, early Spanish explorers, and pirates. Narváez, explorer and governor of Florida, passed through here in 1529. The first known white resident was Odet Philippe, a surgeon in Napoleon's navy. After being captured at Trafalgar and imprisoned in the Bahamas, he settled in Florida. He built a plantation here in 1823.
0.6 46.2 Turn left on SR 590 (Philippe Parkway).
0.3 46.5 Bear right.
0.4 50.5 Bear left.
1.0 51.5 Turn right into PHILIPPE PARK.
0.1 51.6 Bear right.
0.5 52.1 Turn left into unpaved parking area and park.

STOP 2. Indian mounds at Philippe Park. See the paper by Steve Gluckman for a description of this site.

Return to bus and turn right onto paved road.

0.4 52.5 Turn left.
0.1 52.6 Turn right onto SR 590 (Philippe Parkway).
1.2 53.8 Turn right onto SR 580 (St. Petersburg Drive).
2.7 56.5 Bear right and yield at intersection with SR 580 (Hillsborough Avenue).

-----------------------------------------------

NOTE: The optional trip rejoins the road log at this point.

-----------------------------------------------

1.3 57.6 Turn right onto Double Branch Road.
0.5 58.3

Stop at gate to the Hillsborough County Double Branch Creek property. This is a county park presently under development.

STOP 3. Indian mounds at Double Branch Creek. See the article by Steve Gluckman for a description of this stop.

Return to bus and turn around.

0.5 58.8 Turn left onto SR 580 (Hillsborough Avenue).
1.3 60.1 Turn left onto SR 580 (St. Petersburg Drive).
2.7 62.8 Turn left on SR 590 (Philippe Parkway).
1.2 64.0 Philippe Park on right.

-----------------------------------------------

If you are following the optional route, turn left here for STOP 2 (see above).
Bear right.

Bear left.

Turn left on SR 590 (Main Street in Safety Harbor).

Turn left on 10th Street (SR 590).

Turn right on 4th Street (SR 590).

Turn left on CR 593 (McMullen Booth Road).

Turn left on SR 60 (Gulf to Bay Boulevard).


Bear right on SR 60 (Gulf to Bay Boulevard).

Bear left on SR 60 (Cleveland Street).

Turn left on Ft. Harrison Street (US 19A).

Intersection with Court Street. Continue south on Clearwater-Largo Road.

Junction with US 19A to left. Continue straight south on Clearwater-Largo Road.

Bear left.

Bear right on Ridge Road.

Turn right onto SR 688 (Ulmerton Road).

Pull off road on right shoulder near dirt road that leads under bridge and park.

Walk 0.1 mile to Intracoastal Waterway.

STOP 4. Cooke (1945) has described outcrops of Miocene rocks on the beach at Indian Rocks Beach.

Those rocks were assigned to the Tampa Formation. The outcrops were offshore and are not presently visible. The rocks thrown into the spoil at this stop are the nearest available. They consist of fine grained, fossiliferous dolostones which are tentatively assigned to the Hawthorn Formation.

Return to the bus and continue west on Ulmerton Road.

Bridge over the Intracoastal Waterway.

Turn right onto SR 699 (Gulf Boulevard).

Turn left into either the Big Indian Rocks Pier parking lot or 12th Avenue, depending on parking availability. Park wherever convenient.

Walk to the beach along 12th Avenue.
STOP 5. Indian Rocks Beach. Although artifacts are found on this beach, there is no clear origin for the name of the beach. Read the articles by Ron Ceryak and Tom Missimer for details of presentations at this stop.

Return to bus and turn around.

Turn right (south) on Gulf Boulevard (SR 699).


Turn left on Madeira Avenue. Stay in left lane.

Bear left.

Bridge over the Intracoastal Waterway and Boca Ciega Bay. Narvaez landed near the south end of the bay in 1528. There are numerous small Indian mounds on the natural mangrove islands of the bay.

Junction of Duhme Road and Tom Stewart Causeway. Continue straight.

Bear right through construction.

Road is now Tyrone Boulevard.

Turn right in War Veterans Memorial Park.

Bear right.

Bear.

Bear right into parking lot and park. Walk to the southwest along the coast and follow small double-track road to small peninsula on Turtlecrawl Point.

STOP 6. This is a spoil island that contains early Holocene artifacts. See the paper by Al Goodyear, Mark Brooks, and Sam Upchurch on this site. Unfortunately, the site is now being landscaped by Pinellas County and will no longer yield many artifacts.

Return to the bus and continue out of parking lot.

Bear right.

Bear right.

Bear right.

Bear left.

Turn right on Tyrone Boulevard.

Bridge over Long Bayou.

Junction with SR 695. Continue straight.
Junction with US 19N (66th Street N.). Continue straight but get in left lane.

Turn left on 22nd Avenue N.

Turn left on I-275.

Toytown landfill on right.

Junction with I-4. Stay on I-275 (left lanes).

Bear right on Bearss Avenue exit ramp (Exit 36).

Turn left on Bearss Avenue.

Turn right into Holiday Inn parking lot.

LOG OF OPTIONAL DAY 1 FIELD TRIP SEGMENT

0.0 0.0 Turn left (north) on Ft. Harrison Street (US 19A, SR 595).

1.4 1.4 Bear left onto Main Street (US 19A, SR 595).

1.7 3.1 View of Clearwater Beach Island and Caladesi Island to left. This is an impressive contrast in development.

0.4 3.5 Edgewater Park and Dunedin Marina on left. A ferry to Caladesi Island State Park runs out of the marina.

Turn right.

0.1 3.6 Turn left onto Bayshore Road (US 19A, SR 595).

2.7 6.3 Turn left onto Dunedin Causeway (CR 586) at junction. Curlew Road and SR 586 turn to right.

0.9 7.2 Cross St. Joseph Sound. The small spoil islands in the center of the sound are from the Intracoastal Waterway. Artifacts, some of which are very old, are occasionally found on these spoil islands and in the fill of this causeway.

0.4 7.6 View of Caladesi Island on the left.

1.7 9.3 STOP 1A. View of Hurricane Pass. See the paper by Richard Davis for the history of this pass. Rocks, including cherts and the well-known "Tampa Bay geodes", have been found in the spoil at the southern tip of Honeymoon Island. These rocks are from the St. Marks (Tampa) Formation.

Continue north through the parking lot of Honeymoon Island State Recreation Area. The island was laid out for development, which explains the network of paved streets and fire hydrants, and much of the
The State is buying the island now and has plans to provide recreation facilities here. The southern half of the island, the part you are passing through now, will be devoted to heavy public use with bath houses and picnic facilities. The north half of the island, which was not significantly altered by the developers, will be preserved as a natural area. This is one of the finest bird-watching areas in the Tampa Bay area.

Park at north end of parking area. Walk along the beach to the north end of the spoil pile that parallels the beach (approx. 0.2 miles) and/or the large groin.

STOP 1B. This area contains several rock types in the dredge spoils that are characteristic of both St. Marks and Hawthorn cherts and related weathering phenomena. See the paper by Sam Upchurch for an explanation. Numerous Indian artifacts can be found in the surf zone after storms here. Look especially for solution breccias, clacretes and terra rossa soils preserved in limestones and dolostones in the spoil. Rocks that can be assigned to the St. Marks Formation are most common here, although some of the cherts closely resemble Hawthorn cherts.

Return to bus and turn around. Retrace route to US 19A.

Turn left on US 19A.

Community of Ozona.

Turn left at sign for Crystal Beach.

Community of Crystal Beach. Enter small park and beach area. Park.

STOP 1C. The large boulders on the beach at this stop were allegedly removed from the immediate vicinity. They are apparently from the St. Marks Formation and show several interesting features relating to the origin of the cherts of the Miocene in this region. Look for solution channels, terra rossa soil remnants, chertification of porous zones around solution pipes, and small vugs filled with megacrystalline quartz. The paper by Sam Upchurch explains the origin of these features.

Return to bus and turn around. Retrace route to US 19A.

Turn right on US 19A.

Turn left on SR 56 (Curlew Road).


Well developed coastal dunes in this area. These probably accumulated in late Sangamonian time, but have been extensively modified by wind in the arid climate in early Holocene times.
2.7 25.9  Bridge over Tarpon Canal. This canal drains Lake Tarpon, which is approximately one mile north.

2.7 26.2  Turn right onto SR 584 (Hillsborough Avenue).

2.7 26.9  Junction with SR 580. Continue straight ahead and rejoin primary road log at this point.

FIELD TRIP LOG -- Day 2

<table>
<thead>
<tr>
<th>Interval Mileage</th>
<th>Cumulative Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Trip starts at parking lot of Holiday Inn North, 400 E. Bearss Avenue.

Turn left onto Bearss Avenue.

0.1 0.1  Turn right onto ramp for I-75 south.

2.1 2.2  Turn right onto Fowler Avenue exit ramp (Exit 34).

0.2 2.4  Turn left onto Fowler Avenue (SR 582).

0.3 2.7  Intersection with US 41 (Nebraska Avenue). Continue straight ahead.

1.7 4.4  The University of South Florida is on the left. A City of Tampa sewage treatment plant with spray irrigation of secondarily treated effluent is on the right.

1.3 5.7  The building on the right is the new Hillsborough County/City of Tampa Museum of Science and Industry.

2.3 8.0  Pull to shoulder of road and stop before crossing bridge. Walk to river edge on south side of bridge.

STOP 7. Cherts exposed here are typical of St. Marks cherts that have replaced limestones. These blocks have been partly dredged from the river as part of bridge construction, but there is outcrop here as well. These are excellent cherts for making tools and were quarried here and upstream by early Indians. Fossil corals occur in the cherts across the river. The low area across the river is an Indian occupation site (SH1393). See the paper by Sam Upchurch for details of the origin of this chert.

Return to bus and continue east on Fowler Avenue.

0.1 8.1  Bridge over the Hillsborough River. The mouth of Cow House Creek can be seen to the left (north) just past the small park and boat ramp.

0.1 8.2  The archeological site (SH1393) is on both sides of
the road. The site was excavated in 1980 by the Florida Bureau of Historic Sites and Properties because it is in the path of widening of Fowler Avenue out to the I-75 by-pass around Tampa. The site is similar to the one to be visited at stop 9.

**Turn left** onto Morris Bridge Road. Caution, this is a dangerous intersection.

Cross Cow House Creek.

Pull off road and **park**. The shoulder of the road is narrow here, so please be careful. Walk down below the bridge to the west (left).

**STOP 8A.** The chert and limestone exposed in the bed of the creek beneath the bridge are typical of the St. Marks Formation in the area. These outcrops mark the top of bedrock in the area and are usually buried by a residual clay (see the paper by Sam Upchurch). These cherts have been exposed for some time and have been partly altered to tripoli.

Continue to walk downstream (west) for approximately 0.1 mile.

**STOP 8B.** This is archeological site SH1473). It too was excavated by the Bureau of Historic Sites and Properties because it lies in the path of the I-75 by-pass. See the paper by Marsha Chance on this site. Note also, the green, cohesive clay that normally overlies limestone bedrock in this area is exposed on the stream banks. This clay contains fresh cherts that were quarried by early man.

Return to bus and **continue north** on Morris Bridge Road.

The small escarpment is the position of the chert-bearing clay.

**Junction with Fletcher Avenue (CR 582A).** Continue straight ahead.

**Pull off road to the left after the right angle turn to right.** Note the large sinkhole to the south of the road here and the fact that we are on a high dune ridge.

**STOP 9.** This is site SH1472 and was excavated in 1980 as part of the I-75 study. The site extends across the road and includes the large sinkhole. See the paper by Jay Havisir on this site.

Return to bus and **turn around**.

**Turn right** onto Fletcher Avenue (CR 582A).
Note that we are still on top of the high dune ridge. The road will pass down the long, windward side of the dune between here and the Hillsborough River.

1.5 12:0

Bridge over the Hillsborough River.

4.7 16.7

Intersection with Nebraska Avenue (US 41). Continue straight ahead.

1.7 18.4

Bear right on I-75 entrance ramp.

1.1 19.5

Bear right onto Bearss Avenue exit ramp (Exit 36).

0.3 19.8

Turn left onto Bearss Avenue.

0.2 20.0

Turn right into Holiday Inn parking lot. This concludes the trip.

REFERENCES CITED

