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EVIDENCE OF PREHISTORIC MAN AT RAY HOLE SPRINGS: A DROWNED SINKHOLE LOCATED 32 KM OFFSHORE ON THE CONTINENTAL SHELF IN 12 M SEAWATER

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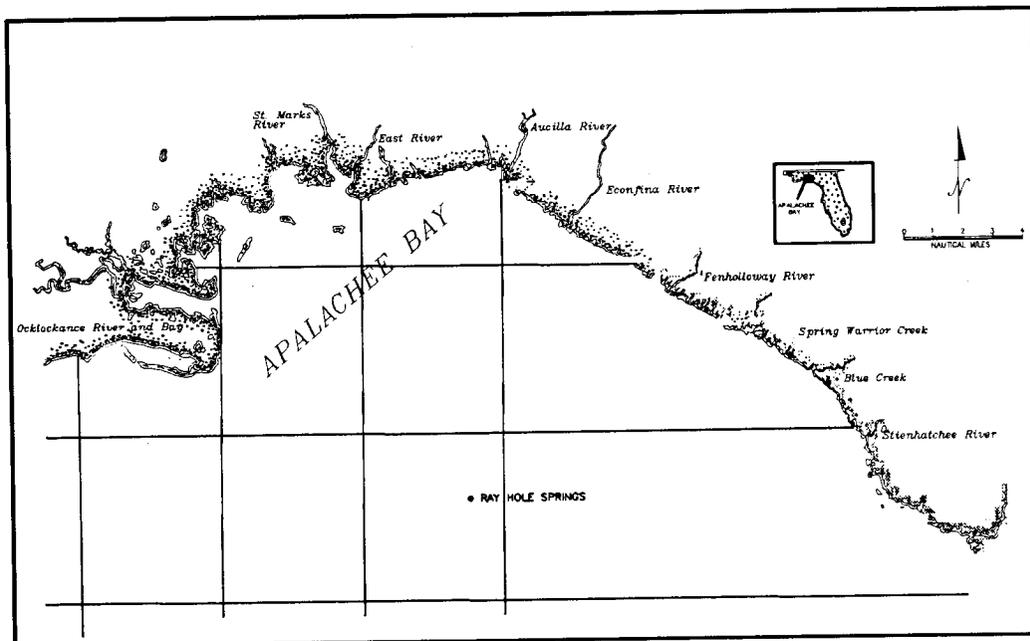
*This paper will discuss a cooperative research effort between academic, State, and Federal agencies that researched and found evidence of prehistoric activity at Ray Hole Spring, a submerged sinkhole. This drowned karst feature is also located in Apalachee Bay, Florida, about 32 km (21 mi) offshore in 12 m of water. Evidence presented in this paper will focus on analysis of carbon dates from organic samples, live oak (*Q. virginiana*) and articulated oyster shell (*C. virginica*), collected at the site. These organic materials were used to reconstruct a sea level curve for this area of the Gulf of Mexico. In addition, scientists have recovered lithic debitage in the form of secondary reduction thinning flakes. This debitage, interpreted as cultural indicators from prehistoric man, was found buried in crevices associated with the rim of this sinkhole feature. These cultural indicators provide irrefutable physical evidence that this submerged sinkhole was utilized by prehistoric man.*

INTRODUCTION

The study of Paleoindians in the New World has been the focus of anthropological research with researchers attempting to answer questions about "where" these prehistoric settlers lived and "how" they survived in the late Pleistocene to early Holocene environment. In the past, the majority of Paleoindian archaeological studies have been in the terrestrial arena and were founded in the scientific method with a strong theoretical background. In the recent past archaeological researchers have been asking these same "where" and "how" questions and finding some interesting answers on submerged inundated sites.

Sites "inundated by the sea are the most elusive sites to locate. These sites may be deeply buried and inaccessible in some regions of the continental shelf...."(Dunbar

submerged early prehistoric sites (Dunbar 1991), but only in recent years have significant discoveries begun to reinforce such views (Dunbar et al. 1992:124-125). The majority of known inundated Early-Archaic sites discovered in the United States are located in the eastern Gulf of Mexico on the Florida Tertiary limestone shelf (Faught 1988 a&b; Dunbar and Waller 1983; Dunbar et al. 1988, and Anuskiewicz 1987 and 1988). This offshore area of karstified limestone deposits has little sediment cover, which enhances the chances in locating and accessing prehistoric sites on the continental shelf. The Apalachee Bay Region of Florida is an ideal geographic and geologic area to search for submerged evidence of prehistoric man (Map 1). This area is located in the northern part of the Florida karst shelf with several spring-fed, low-sediment-load rivers flowing into the bay along with numerous naturally occurring underground caves and surface sinkholes (Dunbar et al. 1989:25).



Map 1. Apalachee Bay Region of Florida.

KARST AND THE SIGNIFICANCE OF PALEOHYDROLOGY AND LITHIC RESOURCES TO PALEOINDIANS

To locate "where" the stone tool dominated Archaic or Paleo-indian sites depends on being able to predict site locations based on models of past human behavior and on geological criteria (Dunbar and Faught n.d.). For prehistoric populations to maintain their lifeways during post-glacial times, they sought out areas rich in varied natural resources. These resources included potable water, food sources (terrestrial, freshwater and marine), and suitable lithic and bone material for tool production.

During low sea level stands, potable water sources on the Florida shelf may have included freshwater rivers, streams, and springs that emptied into the Gulf of Mexico, although some researchers believe most of the karst rivers, those inland, did not have continuous flow until the mid-Holocene. Another important source of water in the

Apalachee Bay area occurs in sinkholes intimately tied to the underground Floridian Aquifer freshwater system. Florida's topographic character in the Tertiary karst region is a well-developed, mature karst with complex underground channel systems. Where the Tertiary limestones are near the surface, numerous sinkholes and other openings connect to the surface. According to Cooper et al. (1953), and Davies and LeGrand (1972), the Floridian Aquifer in the these karstic limestones is one the nations largest groundwater aquifers (Figure 1).

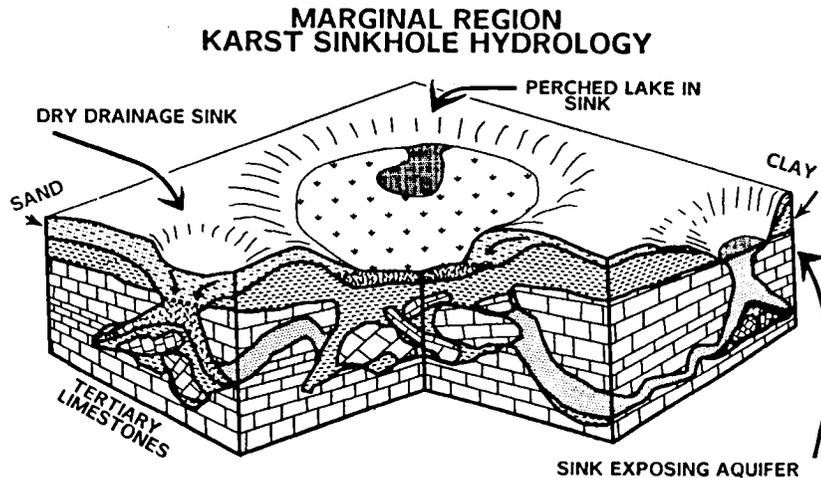


Figure 1. Geologic block diagram of marginal region karst sinkhole hydrology (from Dunbar 1991).

One might now ask how does the Floridian Aquifer system relate to Paleoindian settlement patterns on the continental shelf? Today the Floridian Aquifer is near the surface throughout much of the mainland Tertiary Karst Region. However, during the Paleoindian time frame, the aquifer, like sea level, was lower, and Paleoindian site clusters were concentrated in areas where numerous karst features gave access to persistent sources of water (Dunbar 1991).

Other than the dramatic effects of sea level transgression, it is also important to consider human adaptations from the perspective of the paleohydrology that existed on the continental shelf prior to present inundation. Regardless of yearly precipitation, karst terrains elevated high above groundwater levels tend to be usually dry and support xeric habitats because the porous rock permits water to drain quickly to the level of the aquifer. Therefore, climate, which generally exerts the dominant influence on ecology, is somewhat nullified in limestone regions where karst plays an equally influential part with ecology (LeGrand 1973).

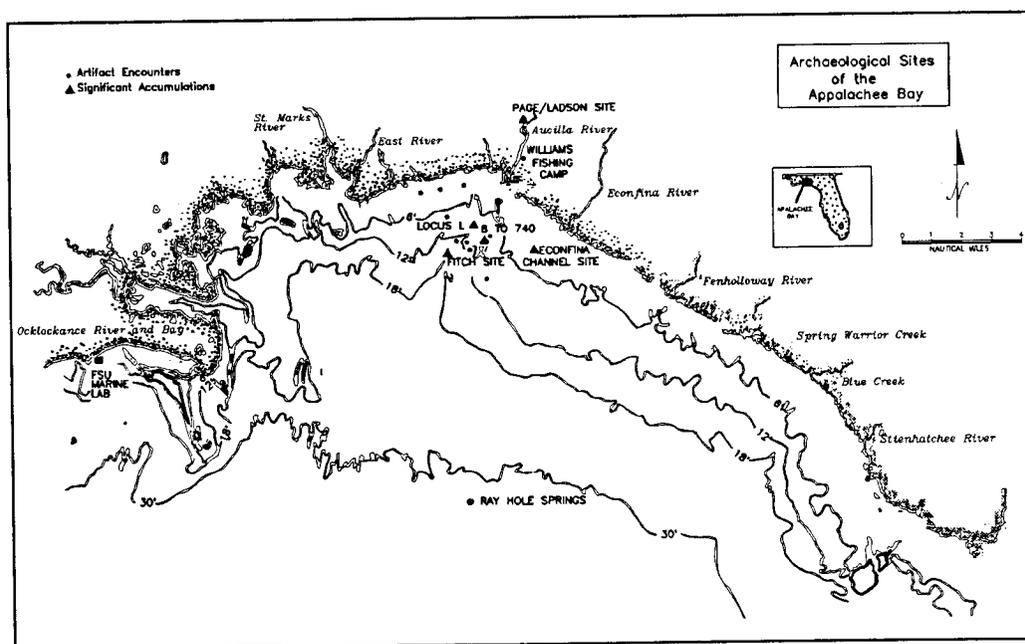
In Florida, the late Pleistocene decline in sea level lowered the karst aquifer about 26 meters or more in some places (Webb 1974; Clausen 1979), and water levels in deep lakes marginal to the Tertiary Karst Region dropped around 18 to 20 meters (Watt 1983). During the late Pleistocene, the Tertiary karst shelf is believed to have displayed a gradation of the ecological variation depending on the elevation of the ground surface above the water table. This in turn was largely affected by the level of the sea. Areas now far out to sea (i.e., Ray Hole Spring-32 km) and nearer to the Clovis shoreline would have been located where the Floridian Aquifer was near the surface.

Lithic resources were also important to Paleoindian and Early Archaic subsistence patterns. Generally, chert bearing limestones comprise a slightly undulating karst plain sculpted by higher sea level stands. The distribution of chert in the karst plain is irregular but frequent. Chert boulders are exposed when the limestone surrounding them dissolves and leaves behind pinnacles of erosion resistant chert rock.

Offshore rock outcrops are one of the most easily identifiable sea floor features on the Tertiary karst shelf. These exposed surface expressions are not hidden by sediment cover and are somewhat easy to detect because the rock is erosion resistant chert or dolomitic limestone.

THE OFFSHORE SURVEY IN APALACHEE BAY AND RAY HOLE SPRINGS

The search for offshore prehistoric sites becomes easier when inundated sinkholes, river channels and chert rock outcrops can be used as convenient guideposts. The irregular, topography-associated features such as submarine sinkholes provide excellent habitat to attract fish and other marine life (Dunbar et al., 1989; Serbousek 1988). Many of the offshore prehistoric sites in the Apalachee Bay area have been discovered as a result of work with fisherman and sport divers who frequent their favorite fishing hole. In Apalachee Bay only a few submerged topographic targets have been inspected, and the results have been extremely fruitful with the discovery of 15 prehistoric sites (Anuskiewicz 1987, 1988; Faught 1988 a&b; 1989, 1990 a&b, 1992, Garrison 1992; Stright 1992, and Dunbar per. com., 1993). Near shore archaeological surveys (inside the State of Florida's 16-km limit) conducted by Faught and Dunbar located 15 archaeological sites (Faught 1992:6) from 1 km to 10 km offshore at depths ranging from 0.5 m to 5.5 m below sea level (Map 2).



Map 2. Map of Apalachee Bay indicating paleoindian and archaic sites locations. Depth contours are shown at 6, 12, 18, 30, and 60 ft below mean sea level (from Dunbar et al. 1992, Faught 1992).

RAY HOLE SPRINGS GEOLOGY

In 1976, The Florida Bureau of Geology Bulletin described Ray Hole Springs as "an occasionally flowing spring lying in 11.6 m of water and measuring 7.6 m in diameter. The north side of the sink slopes southeast and the southeast side has a nearly vertical limestone wall to a depth of 18 m. A cave strikes down and southeast from the 18 m depth to approximately 30 m."

The outer rim of the sink was described by Dunbar et al.(1989:28) as limestone, with minor amounts of silicified rock along the rim of the sinkhole and in the collapsed zone around the rim. Exposed rock, including limestone, and what appear to be dolomitized limestone and chert, was pitted by marine organisms capable of dissolving and implanting themselves into the rock.

Dunbar et al. (1992:131) further describes the geology around Ray Hole Springs as,

The natural bottom surrounding Ray Hole sink consists of a thin veneer of bioclastic detritus and sand above the flat limestone bedrock of a karst plain. Similar to pocked surface of the onshore karst plain, small crevices and solution holes are probably abundant, but hidden by sediment fill and difficult to identify without subbottom profiling equipment....The sinkhole was the only topographic interruption in the otherwise monotonous marine-escape.

1986 FIELDWORK AT RAY HOLE SPRINGS

In the fall of 1986, a cooperative research effort sponsored by the Department of the Interior, Minerals Management Service, Gulf of Mexico Region with support from the Florida Bureau of Archaeological Research and the Academic Diving Program and Marine Laboratory of Florida State University, investigated Ray Hole Springs. Initial diving investigation and reconnaissance revealed that the sink was deeply filled with recent marine sediment. The diving investigation of the sink included diver swimming reconnaissance, site mapping, attempts at auger testing, and water-jet induction dredging at a few selected locations. Auger testing was not successful because the auger could not penetrate the thick marine sediment, and the testing was therefore abandoned.

Next, a 4-inch water induction dredge was employed at random areas around the margins of the sink in an effort to locate sediment pockets that may have trapped lithic artifacts. Several chert-like flakes (pseudo artifacts) were recovered. Initial interpretation of the pseudo artifacts recovered from Ray Hole Springs was that they may represent poorly preserved lithic debitage.

During an excavation of a large crevice filled with typical marine sediment consisting of sand and marine shell detritus, two interesting discoveries were made in the same narrow, deep-test unit. The crevice tested measures approximately 15-20 cm in width and is oriented in a southwesterly direction towards the southern rim of the sink. The first 50 cm or so yielded some possible pseudo artifacts. At about the 70-75-cm level the crevice yielded a lens of oyster shell (*C. virginica*). Samples of the oyster were carefully collected. Continued excavations produced a large piece of waterlogged wood at the bottom of the oyster shell level and lying on the rock bottom at 1 m deep. The wood was collected along with an oyster shell sample. Below the point where the wood

was collected, the crevice narrowed and bottomed out, and archaeological testing was terminated (Anuskiewicz 1987:417; 1988:96). The discovery of wood not damaged by teredo worm and the oyster shell above the wood suggests that wood was deposited in a wet, probably freshwater environment. Later analysis of the wood determined it was live oak (*Q. virginiana*) species. Dunbar et al. (1989:28; 1992:30) states that the discovery of the live oak is strongly suggestive of a coastal hammock environment where salt water intrusion would not likely occur. The oyster shell is indicative of a brackish water environment where saltwater becomes diluted by the influx of freshwater adjacent to the coast, and certain species, notably oysters, flourish. The sand/marine shell detritus, articulated oyster shells, and live oak wood order of deposition indicates that a marine transgressive sequence is present at Ray Hole Springs.

Carbon-14 on both oak and oyster shell strongly support this interpretation. The Carbon-14 date for the oak wood yielded an age of 8,220 +/- 80 years and for the oyster shell 7,390 +/- 60 years, carbon-13 adjusted 7,740 +/- 60 years B.P. (Anuskiewicz 1987:417, 1988:184; Dunbar et al. 1989:28, 1992:31). The carbon dates indicate that brackish coastal environment replaced terrestrial/ freshwater habitats by about 7,700 years ago (Figure 2).

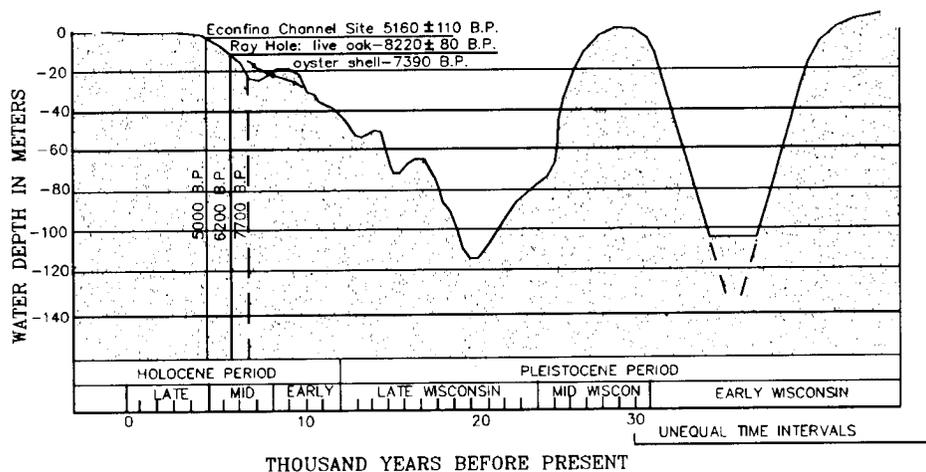


Figure 2. Relative changes on the level of land and sea during the late Quaternary for the Gulf of Mexico. This sea level curve indicates the relative position of Ray Hole Springs based on live oak and oyster samples that were radiocarbon-dated (sea level curve was developed and modified from Coastal Environments, Inc. 1977 revised 1978 and 1982).

ADDITIONAL FIELD WORK AT RAY HOLE SPRINGS

Since 1986, several diving expeditions have been made to Ray Hole Springs to collect additional scientific data. Three of the dive trips in, 1989, 1990, and 1992, involved dredging activities at the site to look specifically for diagnostic lithic artifacts to support carbon dates for the live oak. In addition, 1990 and twice in 1992 vibra-core testing was attempted to gather a stratigraphic sediment sample of the sinkhole sediment cone for paleo-environmental supportive information. Unfortunately, bad weather and mechanical problems with the vibra-core resulted in gathering a 1.3 m core sample. This specific research was conducted in an attempt to gather supporting paleo-environmental sea level curve data to supplement existing information for this area of the Gulf. These

diving operations were a cooperative research effort between the MMS and the National Park Service, Southwestern Region, and the Florida State University, Department of Geology.

INITIAL ANALYSIS AND RESULTS OF TESTING

Testing prior to 1990 at Ray Hole Spring gave us evidence of past brackish water and terrestrial environments from a 1-m deep, sediment-filled crevice. Other tests produced a number of pseudo-artifacts recovered from shallow marine sediments around the rim of the sink. We considered the specimens recovered pseudo-artifacts because they were too corroded by the marine environment for their origins to be certain. These findings raised our hopes that evidence of prehistoric human activity might also be found at the site and that further testing was warranted and pursued (Figure 3).

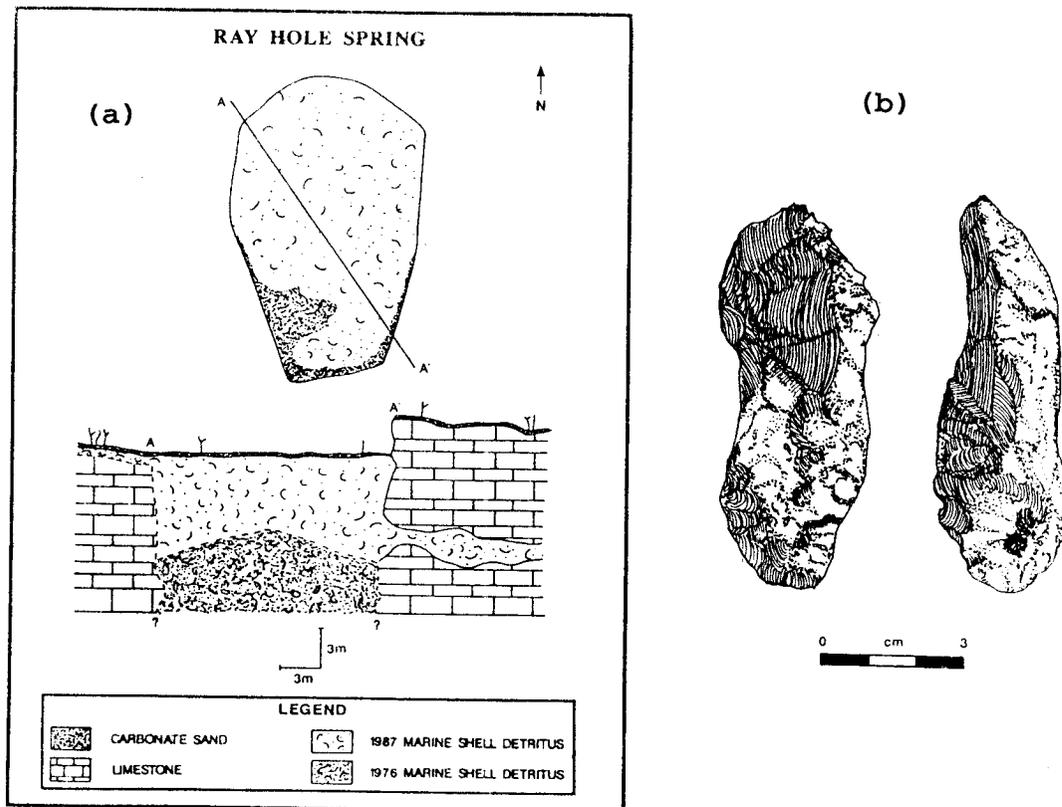


Figure 3. (a) A plan and profile view of Ray Hole Springs, (b) a pseudo-artifact collected from a crevice located at the north-end of the sinkhole (from Anuskiewicz 1987).

Continued testing in 1990 and 1992 was primarily focused in the rim area of the sink in hopes of finding another deep sediment-filled crevice in the limestone bottom. Although no deep crevices were located, several shallow, sediment-filled crevices were encountered and two debitage flakes were recovered. The debitage flakes also displayed a form of corrosion but, unlike the other samples, their exterior remained intact

and allowed them to be positively identified as artifacts. The two debitage flakes, one recovered in 1990 and the other in 1992, have a patina-like corrosion that has transformed the interior of the flakes into an almost pure, caulk-like tripoli. The flakes are similar to chert artifacts recovered in near-surface deposits from sites in Apalachee Bay closer to the present shoreline. The degradation of the flakes by corrosion weakened them, and our collection technique of filling a nylon-mesh sample bag with bulk quantities of shell detritus and rock rubble caused the flakes to crumble around their thin edges. Both flakes show the scars of more than one concoidal flake detachment, and one has a surviving bulb of percussion. Both are also the result of secondary reduction, extracted from a core in an area previously cleared of outer cortex by primary reduction.

ARCHAEOLOGICAL CONTEXT

In 1986, our initial test in the sink at Ray Hole Spring indicated that the marine sediment was too deep for continued excavation. The subsequent discovery of the 1-m deep crevice with sediments indicating sea level transgression changed our focus to tests around the sinkhole's rim. Although no other deep crevices were located, a number of pseudo-artifacts and eventually two debitage flakes were recovered. The context of these specimens can be traced to two stratigraphic horizons. The first is a thin level, usually less than 10 cm thick, of transient, surficial sand deposits that dominate the bottom terrain surrounding the sink along with less frequent natural rock outcrops. A number of pseudo-artifacts, some with multiple flake scars, were recovered from the surficial sand, but displayed decomposed exterior surfaces due to presumed frequent exposure and marine growth. The second sediment type consists of rubble deposits that occur under the surficial sand deposits in crevices and depressions in the limestone that average about 25 cm to 35 cm deep. The rubble deposits consist of a mixture of bioclastic shell detritus and pebble to cobble-size rock mixed with sand, silt and clay. Pseudo-artifacts were recovered from the rubble deposits and include specimens that appeared to have undergone exterior corrosion followed by erosion that removed the corroded exterior and left behind a "ghost" core of a former tool. The two debitage flakes were also recovered from this context and, although it cannot be proven, we believe they were recovered from the deepest recesses of the limestone crevices where they were protected from the effects of erosional events.

Finally, in 1992 a second test (Test 2) was opened in the sink adjacent to the rim. This test proved to be much more interesting in that another deep section containing brackish water sediment was identified. Both oyster and mussel shell dominated the strata with a number of occurrences of still articulated bivalves, which indicate primary deposition. As frequently happens, Test 2 was never completed due to project time constraints, and the brackish water sediment column was never penetrated to expose potential lower stratigraphic levels. The Test 2 area has stratigraphic depth and promises to have in-situ cultural site component(s) still buried. It will be our next target for continued testing.

DISCUSSION AND CONCLUSION

Normally, a terrestrial location would not be recorded as an archaeological site on the basis of two debitage flakes, even though the artifacts demonstrate evidence of past

human activity. There are two reasons why we decided to record Ray Hole Springs as such a site at the end of the 1992 testing session. First, it is the farthest offshore location at the greatest depth below present sea level to have produced prehistoric artifacts in the northeastern Gulf of Mexico. Second, the two debitage flakes, along with several pseudo-artifacts, suggest the site has greater evidence of prehistoric cultural activity. Now that a second area of brackish water sediment has been identified, further testing promises to give us an opportunity to identify potential undisturbed site components.

Future research at Ray Hole Springs should determine how extensively prehistoric peoples used the site. In this paper it has been our purpose to report this archaeological site's existence. Along with the 15 other prehistoric sites in Apalachee Bay it is confirmation of a larger resource base inundated by Holocene transgression. It is a marine resource, once a subject of speculation, that can now be confirmed in the Apalachee Bay region of the Gulf of Mexico. It is a resource base we are just beginning to understand (Figure 4).

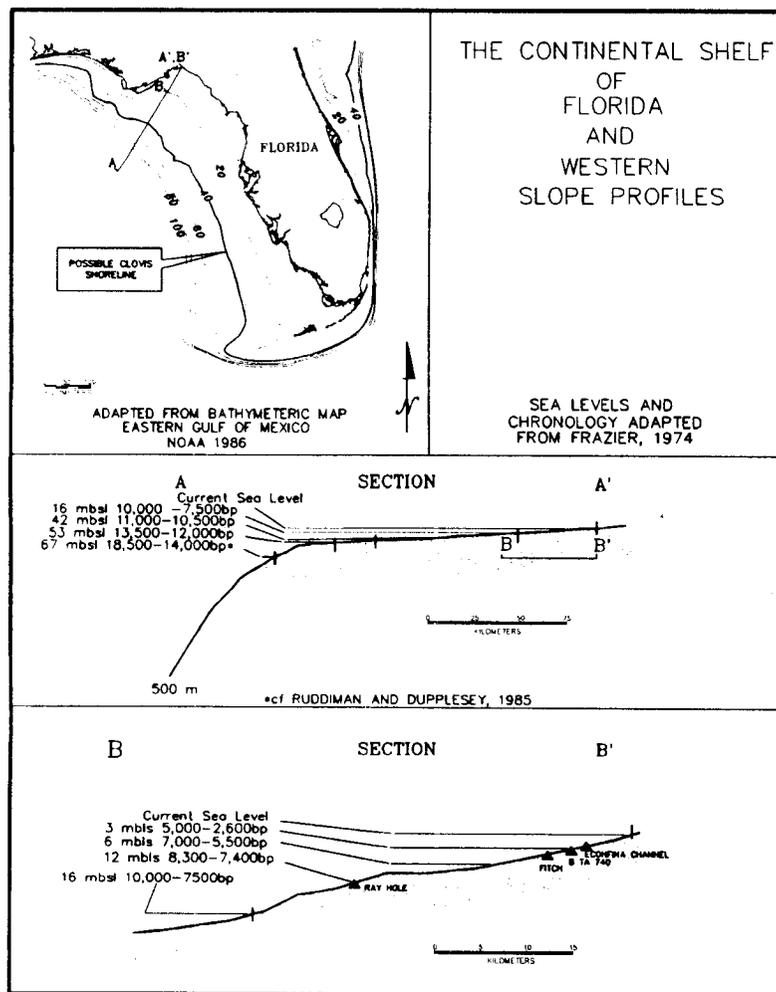


Figure 4. Western slope profiles of the Florida continental shelf (from Faught 1992).

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