# FIELD GUIDEBOOK

to

# ENVIRONMENTS OF COAL FORMATION

IN

# SOUTHERN FLORIDA

Trip Leaders

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PRE-CONVENTION FIELDTRIP

November 16, 17, 18, 1964

59.9 - 88.9 Return to Flamingo Marina via Ponce de Leon Bay, Oyster Bay, Whitewater Bay, Coot Bay and the Buttonwood Canal.

88.9 TERMINATION OF FIELD TRIP. Return to motel for clean up. Time of bus departure for Miami Beach to be announced.

## SITES TO BE VISITED ON THIRD DAY

### STOP 18: Jewfish Key Site

Objectives:

A. Inspection of the effects of shoreline processes interacting with swamp environment processes - Sector 3: The Slough Entry Sector.

B. Inspection of a mature red mangrove forest and red mangrove "peat" from a coastline site.

C. Inspection of a "lime levee".

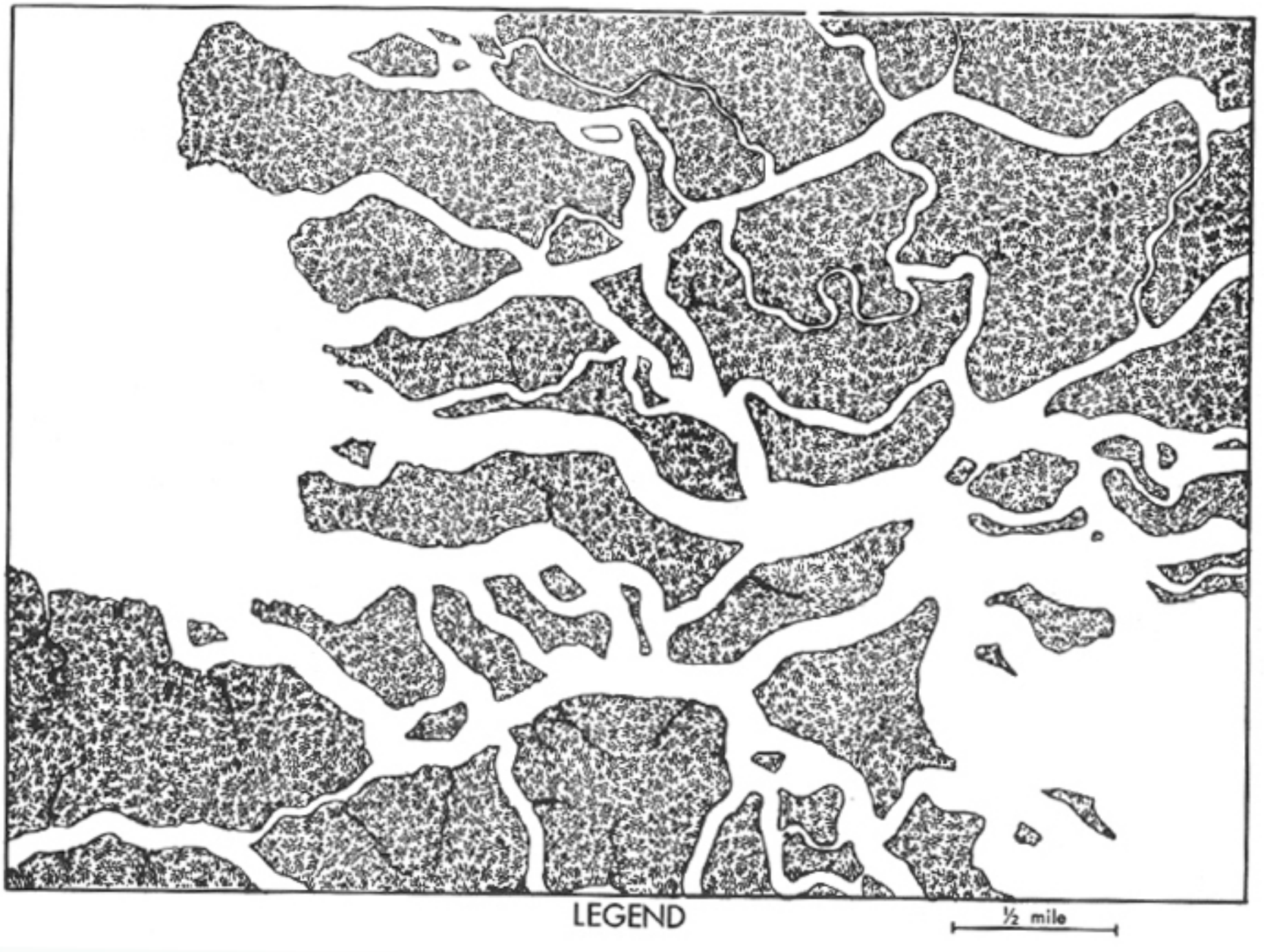
D. Discussion of the mangrove forest swamp and the habits of the red mangrove.

E. Discussion of the chemistry and palynology of the mangrove forest swamp.

Discussion:

This is a unique area. At no other place in the world are red, black, and white mangroves known to achieve the heights that they did in this locality. Unfortunately, but perhaps, normally, the hurricanes of the last few years (particularly Donna in 1961) have smashed into this area taking most of the big trees down. The red mangrove is generally pictured as a shrubby, much-branched tree growing to perhaps 25 feet in height. Here the red mangrove is a straight boled, little-branched tree 50 - 75 feet or more in height.

Figure 37 shows the extensive island system that is coincident with entry of the Shark River Slough into the Gulf of Mexico. This Slough is




MAP OF ENVIRONMENTS IN THE PONCE DE LEON BAY AREA

Figure 37

merely an extension of the Ridge and Slough Sector (see Figure 3) of the Midland Peat Province of southern Florida. These islands, like those in Whitewater Bay, are composed of blocks of "peat" that rest either on the bedrock floor or on a thin layer of marl. In this case, however, the upper half of the block may be composed of carbonaceous mud as opposed to peat. The vegetation in this coastal sector is dominated by red mangrove, as these islands represent relatively exposed sites. An occasional black or white mangrove may be encountered either as relicts of the time when this area was better protected or as chance invaders that managed to survive in an inhospitable habitat. No shrubs, grasses, ferns or other herbaceous plants can survive here. There is no "forest undergrowth". There is no "ground cover". Only where a new environment is developed by ridge development along the island's margin can herbaceous forms survive.

The island on which Stop 18 is located is shown in Plate XVIIA. The hurricane damage is evident from the number of defoliated trees. Some impression of the effects of Donna's 200 mile an hour winds on the mangrove forest can be gained by inspection of photograph B in Plate XVII. The trees in the area of the forest shown were, in general, 50 to 60 feet tall.

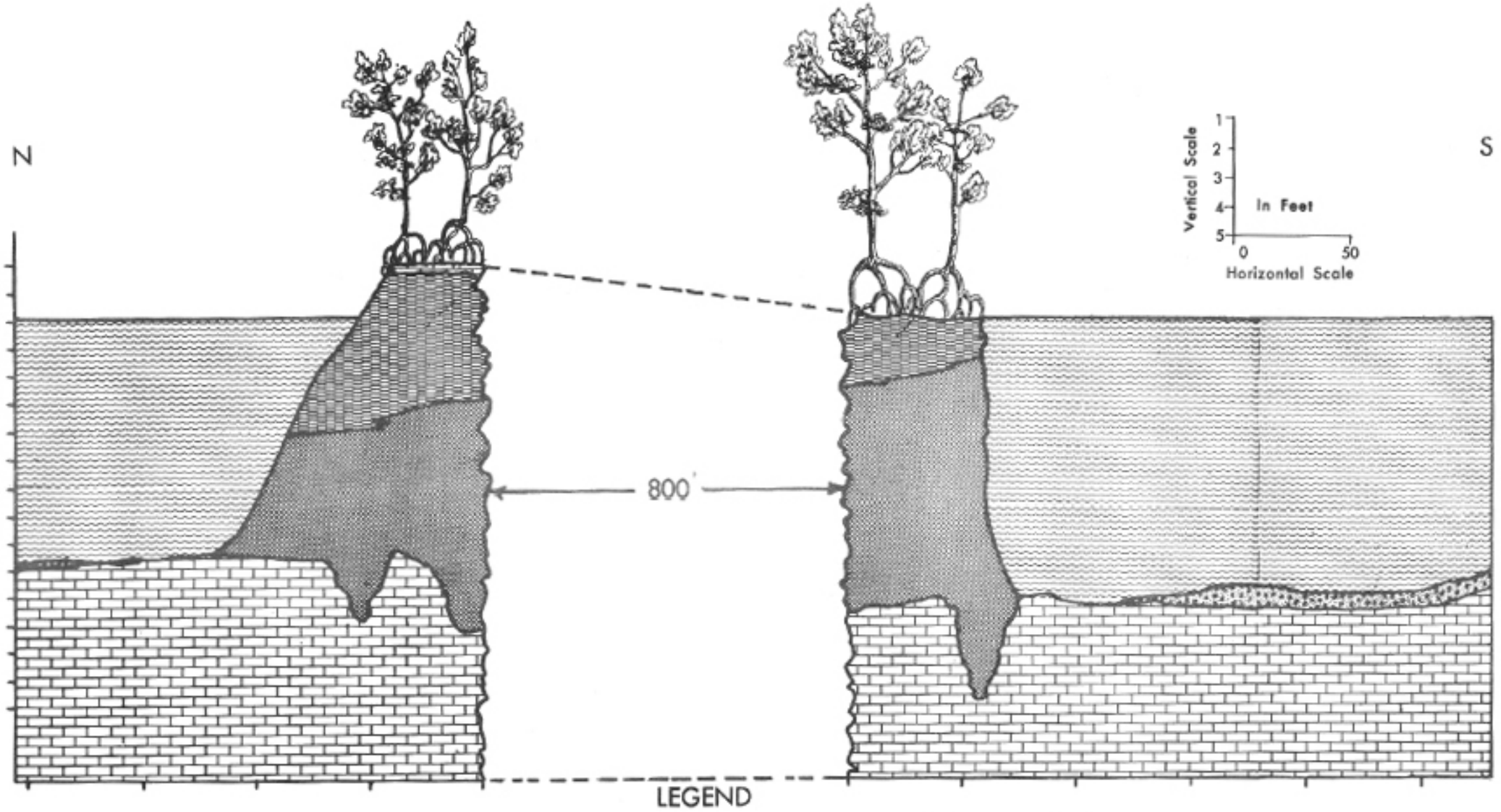
Because there are strong fresh water currents and strong tidal currents flowing past these islands, their sides tend to be steep, often approaching the vertical. The channel floors are generally free of sediment except for occasional shell rubble. The channels often pursue courses that are reminiscent of meandering stream channels and some of the islands appear to be formed as the result of the dissection of a larger island mass whose shape is still discernible. It is difficult to know, however, whether the islands are the product of recent erosional processes or the product of continual upbuilding of ancient island masses in an area characterized by numerous tidal channels.

The islands' surfaces are commonly higher on the sides most exposed to the Gulf or to tidal currents. Figure 38 shows a sectional profile across Jewfish Key, illustrating this fact. This exposed margin will often serve as the site on which a "marl levee" is developed. Figure 39 shows a hypothetical but reasonably accurate representation of one of

a

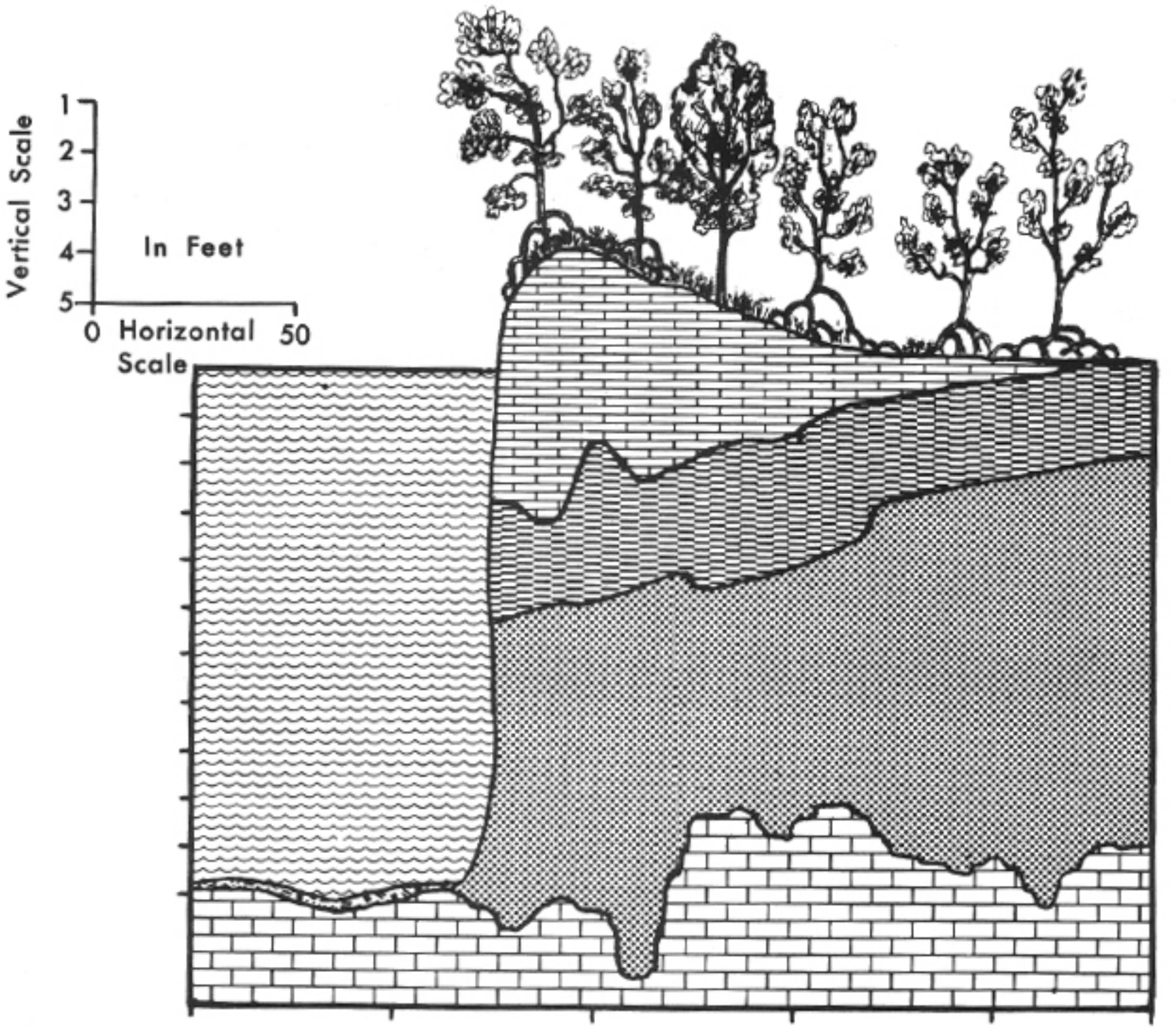
b

PLATE XVII




SECTIONAL PROFILE THROUGH MARGINAL SECTORS OF JEWFISH KEY

Figure 38




LEGEND

WATER PEAT SHELL RUBBLE

CARBONACEOUS MARL MARINE MARL

BEDROCK

GENERALIZED SECTION THROUGH A 'MARL LEVEE'

Figure 39

these ridges in section. The sediment composing them is derived from the calcareous and siliceous muds of the shallow Gulf water nearby. During storms, the bottom muds are churned up and brought inland on high tides. The material tends to be deposited in ridges along the exposed island margins forming the "levees". Some of the mud is carried over the levee and is mixed with the accumulating organic material to form the carbonaceous mud that forms the upper portion of these "peat" blocks. A certain amount of the mud may be brought onto the island surfaces without the aid of storm tides, hence, there probably is a continual mixing of organic and inorganic material on the surface below levee height. The levees are readily recognized from a distance because they provide an environment in which the succulent salt-wort (Batis maritima) can grow. This provides the immediate area with its only herbaceous vegetation.

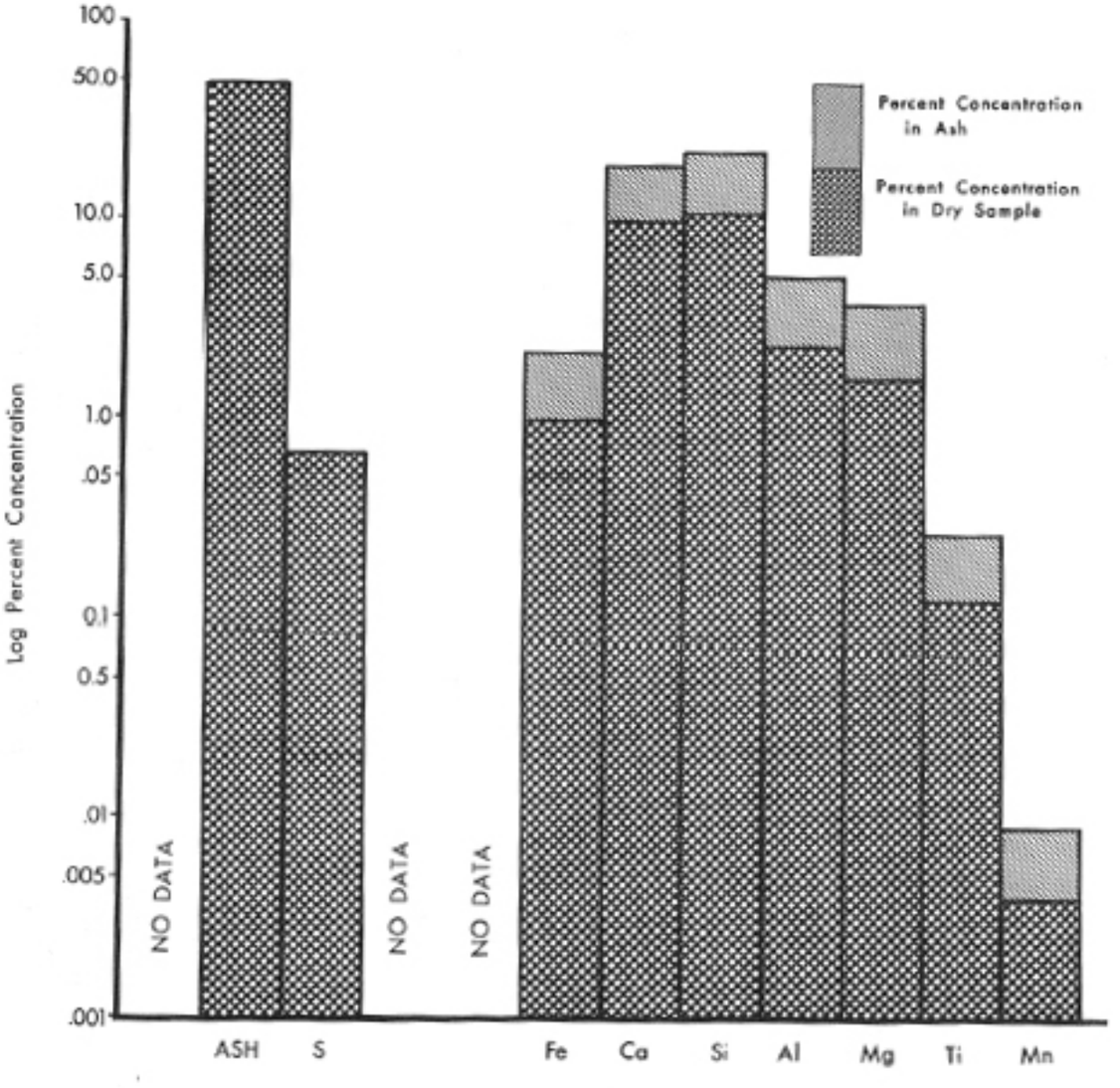
Even though inorganic sediment and organic material are accumulating on the surface of these islands, organic material still moves off in perceptible quantities. The photographs in Plate XVIII are comparable with those in Plate XV and show that similar processes are operating in the two areas.

An attempt has been made to understand the micro-environments and the overall nature of the swamp environment here designated the " Coastal Mangrove Complex". A series of sites was selected "near shore" and another series about one mile behind the shoreline. Surface samples were obtained from these sites and analyzed chemically and palynologically. A rather small range of variation characterizes the analytical results. Figure 40 summarizes the chemical data by presenting simple averages of all data associated with a particular element. The low sulfur content, at first, seems surprising in view of the well-known correlation between sulfur and marine strata associated with coal seams. On an ash-free basis, this value would be doubled, bringing the level to about 1.5 percent. Even more interesting than this is the change that occurs in the concentration of sulfur as one analyzes different levels beneath the surface. Figure 41 shows three such sets of data obtained at a site near the shore opposite Stop 21. In this figure the sulfur and carbon

a

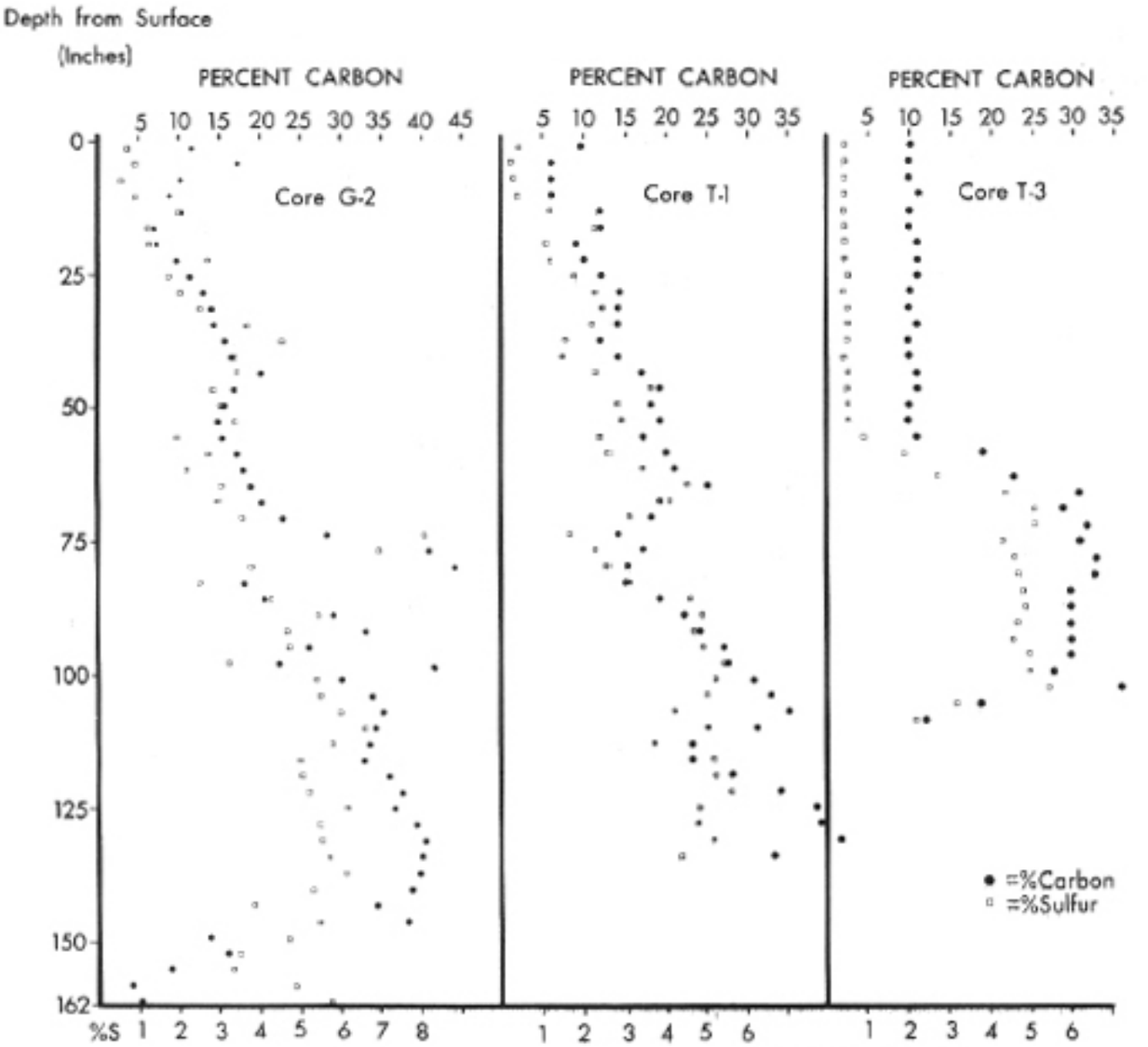
b

PLATE XVIII




ELEMENT CONCENTRATIONS IN SURFACE SEDIMENTS IN THE COASTAL MANGROVE ENVIRONMENTS

Figure 40

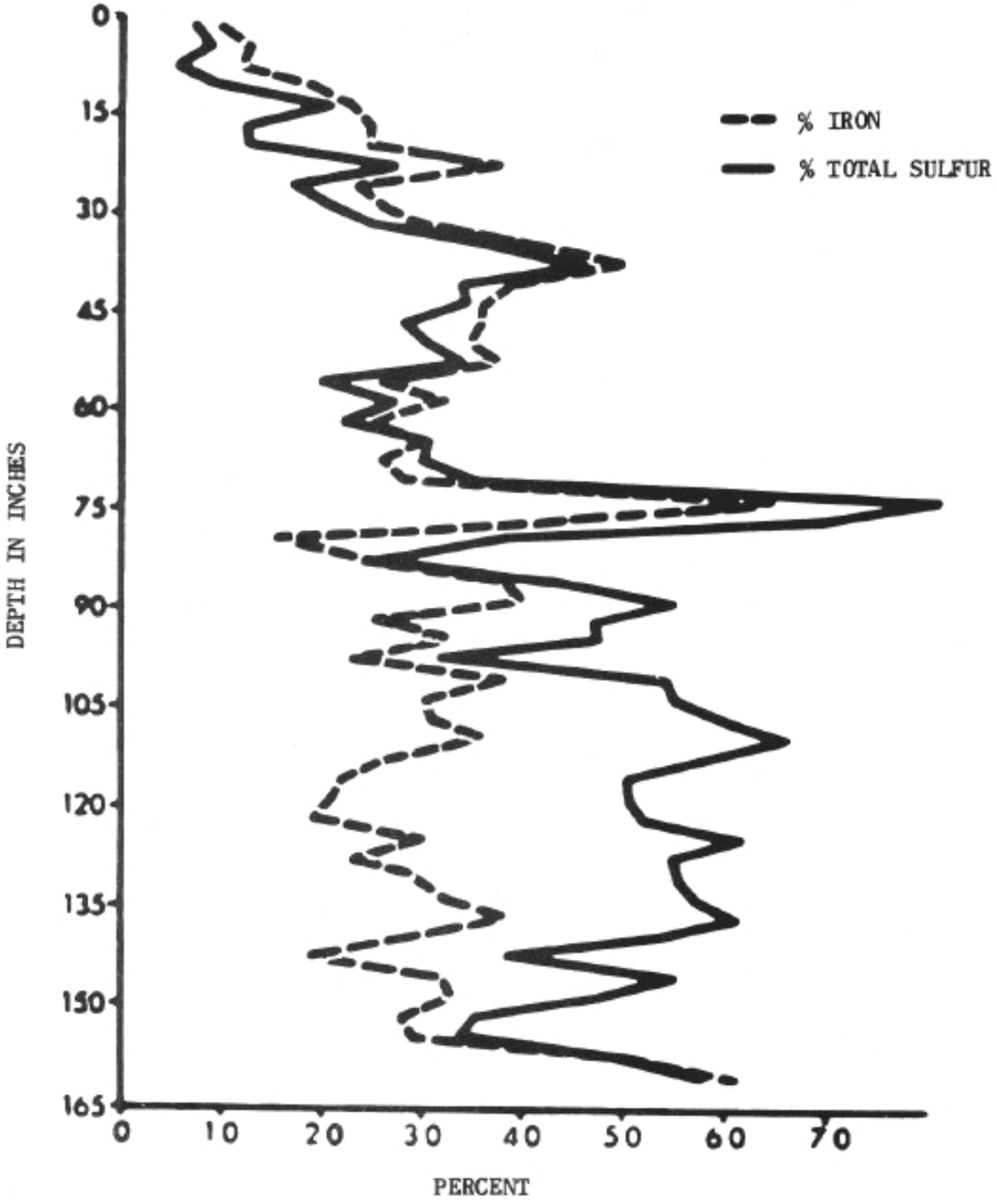



CARBON AND SULFUR CONCENTRATIONS
AT VARIOUS LEVELS IN COASTAL MANGROVE SEDIMENTS
FIGURE 41

are plotted on the same graph. Two facts are noteworthy. First, the high degree of correlation between the two suggest that the living plants may be the primary agents in concentrating the sulfur and contributing it to the environment. It can also be argued that more plant debris permits more bacterial metabolism, hence more sulfur concentration in the sediment. Of additional interest is the fact that when the sediment becomes a true peat (i.e. yields less than 50 percent ash) the sulfur content ranges between 4 and 6 percent. This is much more than that required to account for the sulfur content of most coal seams. Examination of Figure 42 will show that iron tends to be correlated with sulfur in the upper section of the core and not in the lower. This, of course, suggests the development of pyritic minerals in the upper sedimentary layers at this site. A quantitative assessment of the pyrite content of the core has not been made.

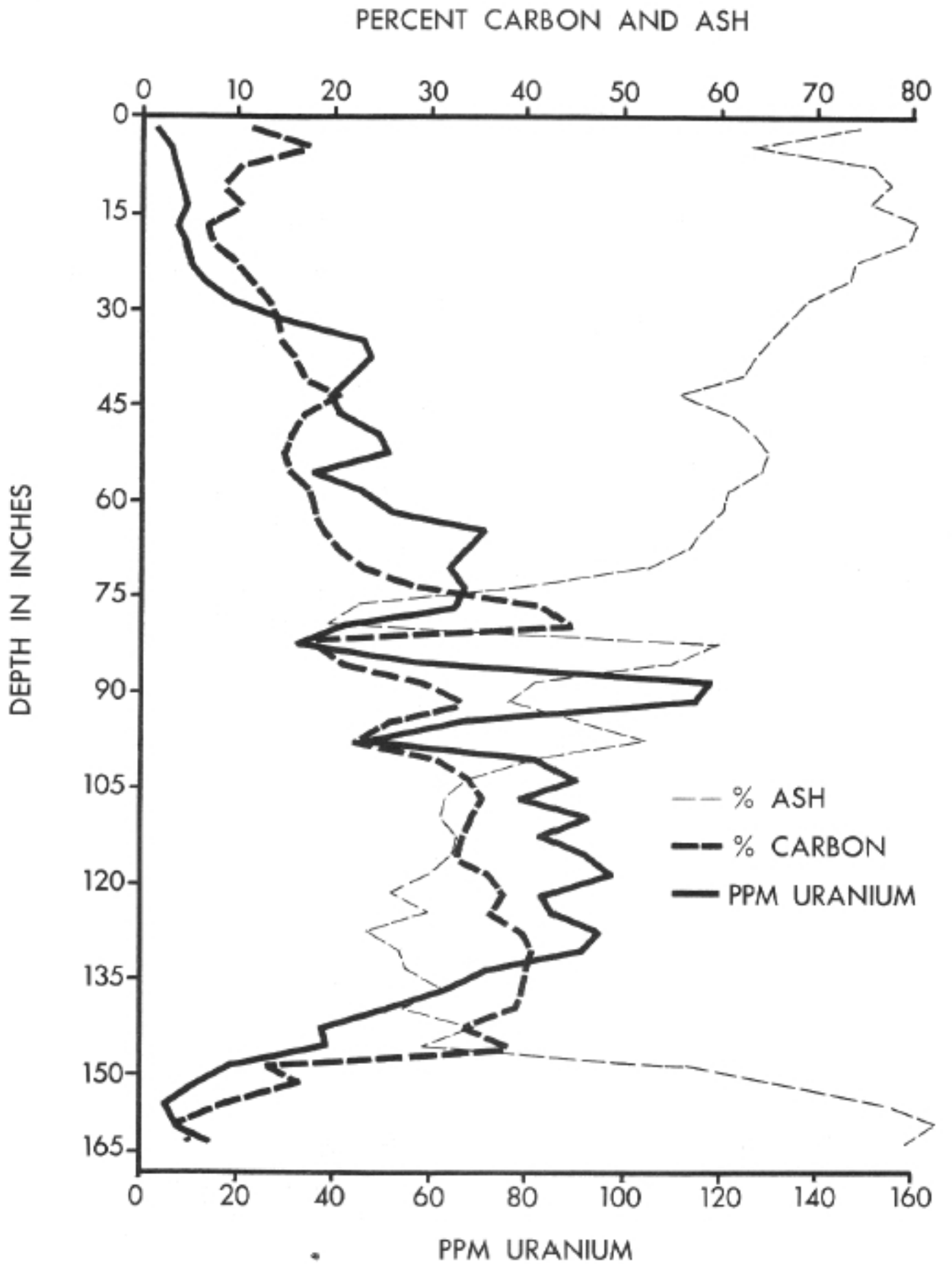
Another element that is present in concentrations that correlate with carbon is uranium. The uranium-ash-carbon relationships are shown in Figure 43.

The pollen and spore content of surface sediment in the Coastal Mangrove Complex appears distinctive of the environment as a whole, and, in addition, it reflects differences from one micro-environment to another. The effects of differences in adjacent vegetation also seem detectable as do north-south and east-west trends in the frequency of various pollen types. Figure 44 presents the frequencies of some of the more significant pollens in the sediment of the mangrove environment. In the same figure similar data are presented for contrasting brackish and fresh-water environments. The ease with which these are recognized is apparent even without a more fundamental differentiation of the pollen and spore types. This, of course, is a case selected for illustrative purposes and full knowledge of the botanical affinities of the pollens and spores should be sought in connection with attempts to make other than gross environmental interpretations. Figure 45 illustrates the trends in the frequency of Rhizophora and Chenopodiaceous pollen as one follows a north-south transect through some 15 miles of the coastal mangrove environments. This serves to illustrate how



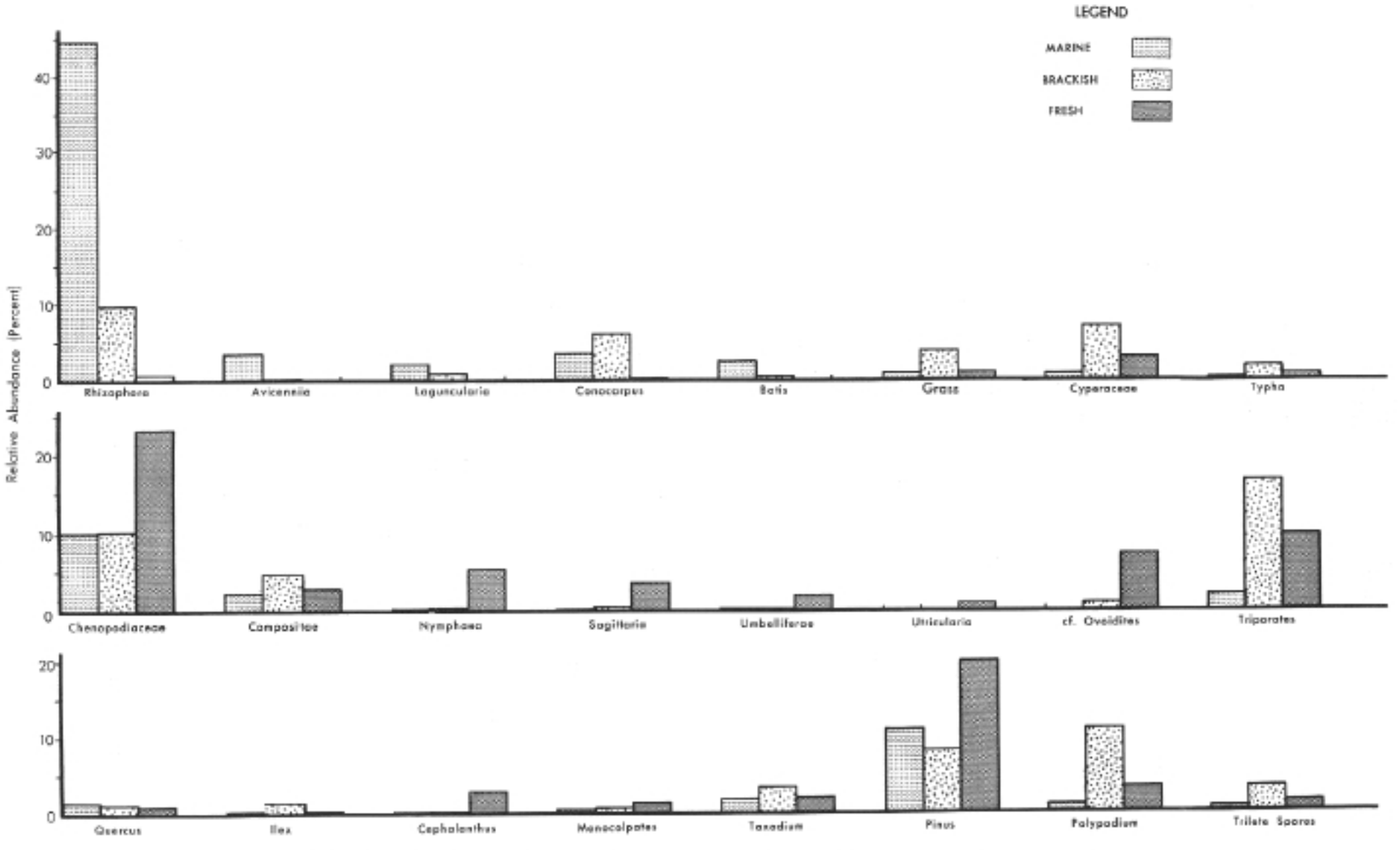

DISTRIBUTION OF IRON AND SULFUR IN CORE 59-G2

Figure 42

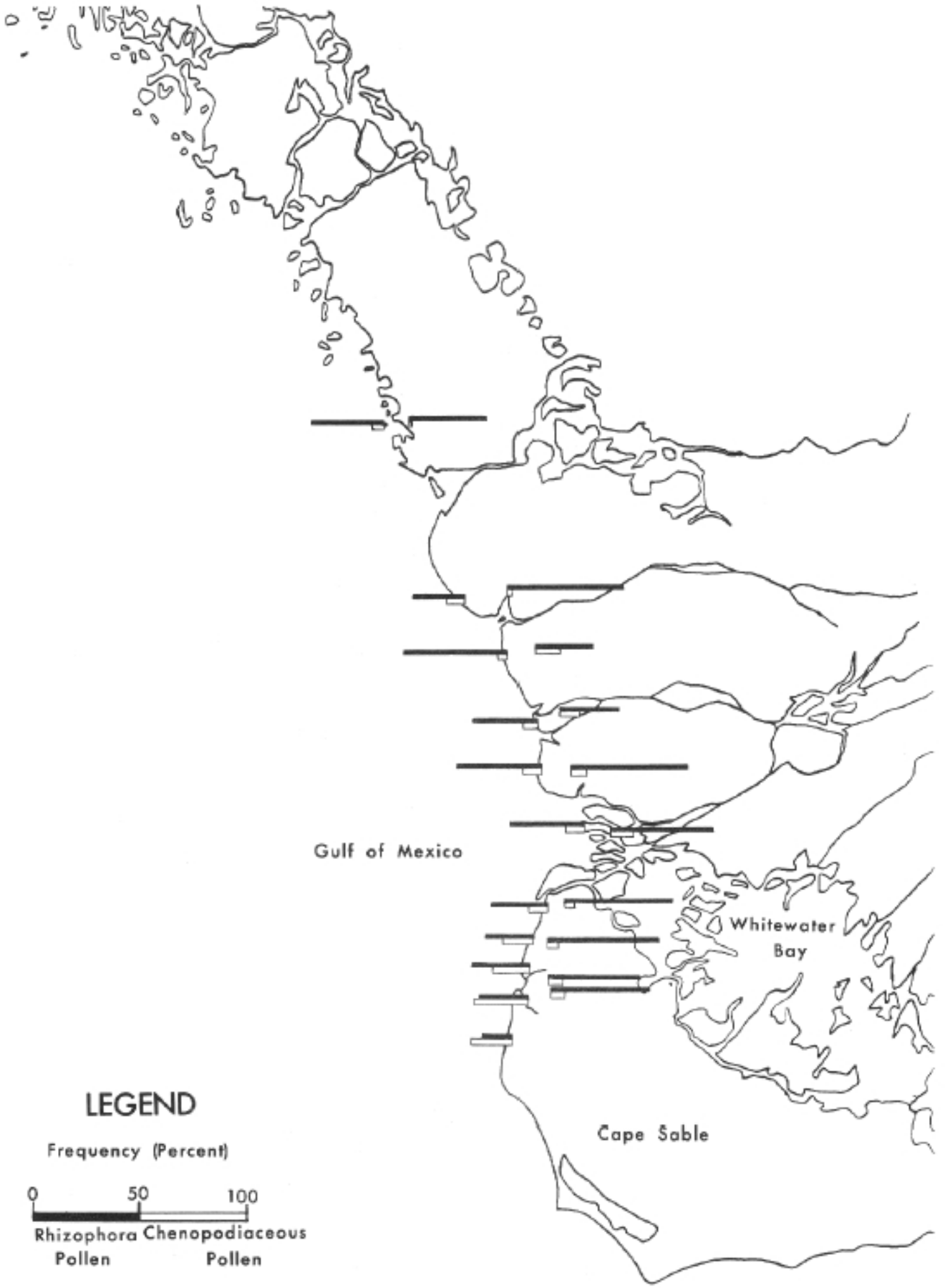



VARIATION IN CARBON AND URANIUM CONTENT
AT SITE 59-T1

Figure 43




COMPARISON OF THE RELATIVE ABUNDANCE OF VARIOUS POLLENS AND SPORES
IN CERTAIN MARINE, BRACKISH AND FRESH-WATER ENVIRONMENTS
Figure 44



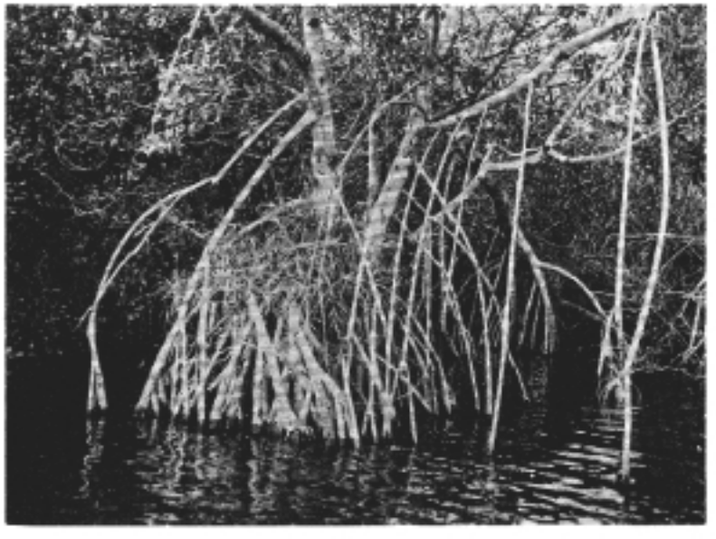

VARIATIONS IN RHIZOPHORA AND CHENOPODIACEOUS POLLEN AT SHORELINE AND "INLAND" SITES IN THE COASTAL MANGROVE COMPLEX

Figure 45

interpretations concerning adjacent vegetation can be made once the pollen signature of a plant community is understood. Salicornia, which makes up a large percentage of the Chenopodiaceous pollen, is clearly not a component of the mangrove forest nor is its pollen characteristic of the mangrove forest signature. The data suggest that it grows in an adjacent community in the Cape Sable Region. This is, in fact, the case.

Stop 18 represents just one of the environments in the Coastal Mangrove Complex. Others include almost pure black mangrove stands, various mixtures of red, black and white mangrove, and still others that include additional hardwood plants. It may be of value to note the changes in the growth habit of the red mangrove and the associated changes in the composition of the mangrove forest as one proceeds upstream from the open Gulf. As shown on Plate XIX and as previously noted, the red mangrove at the mouth of the Shark River is a straight boled tree with a few, sturdy, basal prop roots. It is often unbranched for the first 30 feet and bears a well-formed crown that may extend to 75 feet. Few, if any, adventitious roots arise from the lofty branches. The trunk is conspicuous, light-colored, often tinged with orange and dotted with tree snails and mangrove crabs. As one proceeds upstream, the height of the red mangrove is gradually reduced and the habit is changed. The prop roots become more numerous and less sturdy; the main trunk becomes less erect and less conspicuous; the adventitious roots become more numerous, arising from many branches and dangling toward the water. Further on, the trunk of the tree becomes invisible behind a shrubbing of leaves that now reaches the water's edge. Close inspection may reveal the trunk to be horizontal in attitude without any remaining connection with the place in which it was first rooted. On upstream, the red mangrove becomes even smaller and becomes limited to a narrow fringe along the stream margin. Here other plants participate with the red mangrove in forming the streamside vegetation including buttonwood (Conocarpus erectus), pond apple (Annona glabra), willow (Salix spp.) fig (Ficus spp.)and grape (Vitis spp.). Beyond the headwaters of the Shark the red mangrove exists in the open Everglades in the form of small bush-like trees with many thin prop and aerial roots, and no discernible main stem. In certain areas,"second growth"stands have developed, both near the open Everglades and along the river courses.

a



b

c

d

PLATE XIX

These "shade grown" trees possess the habit of young counterparts of the Shark River giants and may in fact be such. These unusual growth habits plus the great ecological amplitude of the species, plus the viviparous method of reproduction, make these plants interesting even to the casual observer.

STOP 19: Tarpon Bay Bulrush Site

Objectives:

A. Inspection of a marsh environment dominated by Scirpus.
B. Inspection of remnant saw grass peat mounds on marsh levels supporting Scirpus spp.
C. Discussion of environmental changes occurring upstream from Tarpon Bay.
D. Discussion of element concentration in Scirpus vs Mariscus environments.
E. Discussion of changes in element concentration and pollen content in surface sediments in a transect from marine open water to the fresh-water Everglades.

Discussion:

The map of environments in the Tarpon Bay area (Figure 46) shows only three environments of areal importance in this locality: the open water channels, the streamside forest and the Scirpus - Mariscus marsh. An impression of the height of the mangroves in the streamside forest and the width of this channel-fringing environment in this area can be obtained from the aforementioned figure and Plate XX. The type of marsh shown in the Plate covers large areas in the brackish water zone. Because they are usually concealed to the water traveler by the streamside swamp, they have received little attention in the past. In many places saw grass is much less conspicuous in the environment than it is at Stop 19 and may be completely absent over large areas. As one proceeds inland from this locality, the Scirpus marsh soon disappears and the saw grass and spike-rush environments dominate the marshland area. The streamside forest continues to thin and finally disappears as the Shark River headwaters become indistinguishably a part of the surficial water flow in the Slough area (Plate XXI).