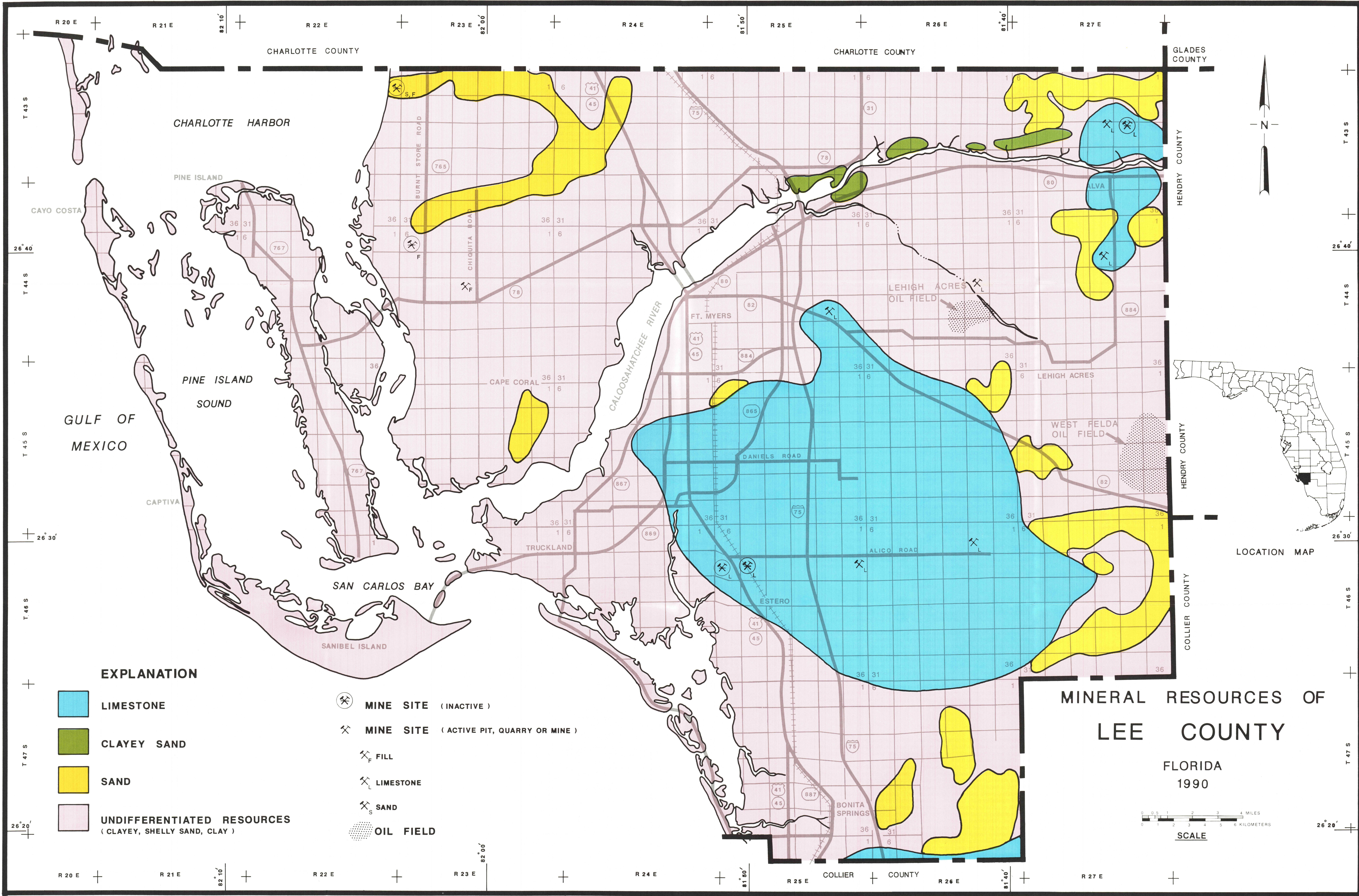




GEOLOGY

MAP SERIES NO. 130

MINERAL RESOURCES OF
LEE COUNTY, FLORIDA

BY

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LEE COUNTY

INTRODUCTION

In recent years, considerable attention has been focused on Florida's rapid development, the accompanying population increase and their effect on the state's important mineral resources. Frequently, urban development has occurred in areas underlain by known mineral deposits, which precludes future extraction of the minerals. The economics associated with these mineral resources represent substantial employment and income to the private sector as well as taxes to county and state governments. One response to this growing conflict between rapid growth and development of the state's mineral resources was in the form of legislation enacted by the Florida Legislature in 1985 requiring each county to establish a comprehensive land use plan. Additional guidelines and due dates were established by the 1986 Florida Legislature.

In response to this act and at the request of the Lee County Commissioners, the Florida Geological Survey initiated a study of Lee County's mineral resources. The objective of this report is to summarize and interpret geologic data (i.e., core and well cutting descriptions, geophysical logs, and data derived from field reconnaissance) in a format appropriate for use by city and county planners.

A knowledge of Lee County's mineral resources is basic and integral to the process of initiating, developing and implementing an effective comprehensive land use plan. This information and data are essential to planners and officials in their analyses of urban and rural development in such areas as zoning, road construction and the establishment of waste disposal sites.

Factors used in evaluating the economic value of the county's known and potential mineral resources are varied, changing, and in many instances interrelated, thus complicating an accurate assessment. The evaluation process is inherently dependent on an extensive exploration program, a necessary precursor to mining in order to determine reserves, content and extent of specific mineral resources. In addition, such factors as operating expenses, beneficiation, reclamation and capital costs of mining must be included in the overall calculations.

Resource evaluation for this report is based on a number of sources including Florida Geological Survey reports and unpublished data, field reconnaissance, county, state and federal statistical data, company reports, questionnaires, and numerous discussions with mining company personnel and state and federal officials. Although detailed information on company statistics is confidential, information of a more general nature is readily available or can be reasonably extrapolated from existing data. The diversity of sources as well as their close association to the various aspects of resource evaluation lends substantial confidence to the general assessments and inferences of this report.

METRIC CONVERSION FACTORS

In order to prevent the duplication of English and metric units in this report the following conversion factors are provided.

MULTIPLY	BY	TO OBTAIN
feet	0.3048	meters
miles	1.609	kilometers

GEOMORPHOLOGY

White (1970) and Lane (1980) are the primary sources used in the following discussion of the geomorphology of Lee County. White (1970) subdivided Florida into three geomorphic zones and designated the southern part of the peninsula as the Southern or Distal zone, which includes Lee County. Within this zone are several geomorphic features, including the Immokalee Rise, the Caloosahatchee Valley, the Southwestern Slope, the Gulf Coastal Lagoons and the Gulf Barrier Chain (Figure 1). Lee County is generally flat, sloping gradually upward from sea level along the Gulf Coast to elevations between 20 to 30 feet above mean sea level (MSL) at its eastern boundary.

The Immokalee Rise has the highest topographic elevations in the county, which range from 25 to 42 feet MSL. Its boundary on Figure 1 is approximated by the 25-foot-elevation contour. Surficial sediments associated with this feature are medium to fine sand and silt overlying shell or limestone. Sand thickness generally increases with higher elevation, which supports White's (1970) theory that the Immokalee Rise originated as a submarine sand shoal when sea level stood higher than present, possibly during the Pleistocene.

North of and contiguous to the Immokalee Rise and the Southwestern Slope is a large feature known as the Caloosahatchee Valley. This lowland extends as far east as Lake Okeechobee and occupies most of the northern half of Lee County. It is underlain by clayey sand and shell units and limestone. This valley generally has elevations less than 25 feet MSL.

Another relatively large geomorphic feature present in the county is the Southwestern Slope. This feature borders the Caloosahatchee Valley on the southwest and the Immokalee Rise on the southeast. The Southwestern Slope varies in elevation from a maximum value of 25 feet MSL to sea level at the coast. The area is covered by a relatively thin veneer of sand which is underlain at shallow depths by clay, shell and limestone units (Lane, 1980).

A nearly continuous sequence of barrier islands is present along the coast of Lee County. These islands, known as the Gulf Barrier Chain, are separated from the mainland by the Gulf Coastal Lagoons. Associated with these islands is a system of sand dunes that is seldom more than one mile wide and 10 feet high (Lane, 1980). White (1970) speculated that these barrier islands may have formed locally from sand eroded from headlands.

Several relict marine terraces are present in the county. These features were formed during higher sea level stands that occurred in the Pleistocene Epoch. Based on elevation, Healy (1975) recognized three terraces in Lee County (Figure 2). In order of descending elevation, they are the Talbot Terrace (25 to 42 feet MSL), the Pamlico Terrace (8 to 25 feet MSL) and the Silver Bluff Terrace (less than 10 feet MSL).

Lee County is underlain by a thick sequence of sedimentary rocks ranging in thickness to at least 15,600 feet (Barnett, 1975; Arthur, 1988). Below the sedimentary sequence, Middle Jurassic (mid-Mesozoic) igneous rocks (approximately 163 million years old) were encountered. The igneous rock sample was recovered from an oil test well (W-10566) in southeastern Lee County (section 14, Township 45 south, Range 27 east) from 15,618 feet below MSL. These rocks, referred to as basement rocks, are overlain by more than 10,000 feet of primarily carbonate rocks (limestones and dolomites) with minor siliclastic sediment units (sand and shale). Carbonate deposition predominated from the mid-Jurassic through the Oligocene (163 to approximately 25 million years ago). The post-Oligocene (Miocene and younger) sediments consist of interbedded and mixed siliclastics and carbonates. Figure 3a is a map showing cross sections used in this report.

Eocene, Oligocene and some Miocene carbonate rocks form the Floridan aquifer system, one of the world's most productive aquifers. The Floridan aquifer system in Lee County consists of the Eocene Avon Park Formation and Ocala Group, the Oligocene Suwannee Limestone and the lowest part of the Miocene-Pliocene Hawthorn Group. The major rock types are limestones and dolomites with only a minor siliclastic component. Water quality in the Floridan aquifer system in Lee County is poor due to high chloride, sulfate and total dissolved solids (Wedderburn et al., 1982).

The Miocene-Pliocene Hawthorn Group occurs throughout the county, generally within 125 feet of the surface (Figures 3b and 3c). The Hawthorn Group consists of a lower carbonate unit, the Arcadia Formation, and an upper siliclastic unit, the Peace River Formation (Scott, 1988). Phosphate is present in varying amounts throughout these sediments. The Hawthorn Group total thickness ranges from less than 500 feet in the northwest to more than 700 feet in the east and southeast parts of Lee County. Wedderburn et al. (1982) recognizes 850 feet of Hawthorn sediments in the northeastern corner of Lee County. Since the majority of water wells in Lee County do not completely penetrate the Peace River Formation of the Hawthorn Group, the Peace River Formation is the deepest unit represented on the cross sections.

Sediments of the Hawthorn Group form the intermediate aquifer and confining system including two main aquifers, the Sandstone and mid-Hawthorn aquifers, and three confining zones, the lower, mid- and upper Hawthorn confining zones (Wedderburn et al., 1982). The confining characteristics of the Hawthorn Group sediments also serve to confine the Floridan aquifer system. Water from the producing zones in the Hawthorn is better quality than the underlying Floridan aquifer system (Wedderburn et al., 1982).

The Pliocene Tamiama Formation overlies the Hawthorn Group throughout the county and is the oldest formation exposed in Lee County. During low water stages, the Tamiama sediments are exposed along parts of the Caloosahatchee River in northeastern Lee County. Many pits in the county expose the Tamiama Formation. The Tamiama exhibits moderately variable lithologic characteristics ranging from a poorly indurated, quartz sandy, clayey, phosphatic, fossiliferous calcareous mud (often referred to as a "marl") to a well indurated, quartz sandy, slightly phosphatic, fossiliferous limestone. In the northwestern portion of the county, a very fossiliferous quartz sand with a clay and carbonate matrix occurs in the upper Tamiama Formation. The thickness of the Tamiama Formation is variable in Lee County ranging from less than 10 feet to more than 100 feet. In general it thickens in a north to south trend. The top of the Tamiama ranges from approximately 20 feet above MSL to 40 feet below MSL.

The Caloosahatchee and Ft. Thompson Formations overlie the Tamiama Formation in many areas of Lee County. The fossiliferous sands and carbonates of these units are often less than 10-feet thick but exceed 60-feet thick in limited areas. Many mining operations expose the Caloosahatchee and Ft. Thompson Formations. As the result of difficulties separating Caloosahatchee and Ft. Thompson on a lithologic basis, the units are shown on the cross sections as undifferentiated Caloosahatchee/Ft. Thompson Formation.

Undifferentiated Pleistocene-Holocene sediments overlie the Caloosahatchee-Ft. Thompson sediments in Lee County. These sediments vary from unfossiliferous quartz sands to very fossiliferous sands and shell beds, thin marl beds and organic-rich sediments. The undifferentiated sediments generally occur as thin beds less than 10-feet thick. However, along the coast these units can exceed 20-feet thick.

Sediments belonging to the Tamiama, Caloosahatchee and Ft. Thompson Formations and the undifferentiated Pleistocene-Holocene sediments comprise the surficial aquifer system in Lee County. Wedderburn et al. (1982) indicate that the surficial aquifer system ranges from less than 15 feet to more than 125 feet in thickness. Water quality in the surficial aquifer system while it is not exceptionally good, is better than that in the intermediate aquifer and confining system (Wedderburn et al., 1982).

MINERAL RESOURCES

Introduction

The purpose of the following discussion is to provide information on the occurrence of certain economic mineral commodities in Lee County. The information presented is not intended to be an exhaustive investigation leading to immediate industrial development. However, where the information is favorable it may indicate that certain areas warrant further investigation. The Mineral Resources Map is designed to present a geographic overview of the major economic mineral commodities identified in Lee County. Factors such as thickness of overburden, quality, and volume of the deposit could affect the mining of the mineral commodity at any specific site. In contrast, geologic cross sections have been extrapolated from cores and/or well cuttings to show the distribution and thickness of surface and near-surface stratigraphic units (Figures 3b and 3c). As a result, occasional variations between the geologic cross sections and the Mineral Resources Map may occur. The principal economic mineral commodities occurring in Lee County are limestone and sand. In addition, a brief discussion of petroleum is included.

Limestone

The extraction of limestone dominates the mining industry of Lee County. The commodity is present in the very near-surface sediments of eastern Lee County. Schmidt et al. (1979) indicates that this limestone belongs primarily to the Pliocene Epoch Tamiama Formation. It is comprised of tan to white or gray, poorly to well indurated, sandy, moldic limestone.

The limestone of the Tamiama Formation is mined by six companies in Lee County. These companies are located east of the north-south trending Interstate Highway 75. They utilize the open pit mining methods which are common to much of the southeastern United States. Bulldozers clear away overburden which normally ranges up to 15 feet in thickness. The limestone, once cleared, is fractured by heavy machinery or explosives. The broken rock is then loaded by dragline or front-end loaders into trucks and transported to rock crushers for processing. The water table is often encountered in the limestone pits. When this occurs, draglines are used to extract the limestone under water to depths approaching 45 feet.

The Tamiama Formation mined in Lee County is primarily used as a base material in roadway construction and as an aggregate grade rock for concrete and asphalt. Other uses of limestone include riprap and drainfield aggregate. The fines (material remaining after the production aggregate) are included as filler material in bituminous mixes used in road surfacing.

Sand

Quartz sand occurs on the surface and in the near-surface of Lee County. North and west of the Caloosahatchee River, siliclastic sediments as thick as 50 feet are present. These sediments are comprised of clayey, shelly quartz sand, which is occasionally cemented to form sandstone (Lane, 1980).

Although mining in Lee County is usually associated with limestone, there are a few existing and abandoned operations which extract sand. The majority of these operations are located in the northwestern part of the county in the vicinity of Burnt Store and Chiquita Roads. This material is used locally as a source of fill material.

The Florida General Soils Atlas (Spielberger, 1975) rates soils as to their suitability as sources of material for many categories. Materials suitable for two of these categories (sand and roadfill) occur in Lee County. A soil, which is labeled as a good source of sand, meets the criteria of being at least three-feet thick. A soil rated as good for roadfill means that it is well suited as embankment material when compacted and is easily removed from borrow pits. Soils rated as good sand sources are most abundant in southeastern Lee County, south of Immokalee Road and east of U. S. Highway 41. Small areas of good sand are also found in the northwestern and northeastern portions of Lee County. The Lee County Land Use Plan Map (1984) designates many of these areas as environmentally sensitive areas. Approximately 90 percent of the county is rated as good for roadfill material by Spielberger (1975) who considered only the uppermost 80 inches of the ground in preparing his report.

Petroleum

Two oil fields are located in Lee County (Mineral Resources Map). These fields (West Felda and Lehigh Park Fields) were discovered in 1966 and 1974, respectively. The Upper Cretaceous Sunnland Formation is the producing horizon for both oil fields and occurs at depths of 11,890 feet below land surface for the Lehigh Park and 11,450 feet for the West Felda Field. The Lehigh Park Field, through the end of 1985, produced 4,536,720 barrels of oil and the West Felda Field, through 1985, produced 38,150,947 barrels of oil (Applegate and Lloyd, 1984).

Undifferentiated Resources

Much of Lee County has surface and near-surface sediments comprised of clayey, shelly sand, marl and organic muck. These undifferentiated resources have extensive occurrences in the northeastern portion and the western half of the county. Any large scale economic utilization is diminished by the heterogeneous nature of these sediments. However, they are locally valuable as fill, since many areas are subject to flooding and require fill for building and development purposes. In addition, these sediments have use as topsoil and roadfill.

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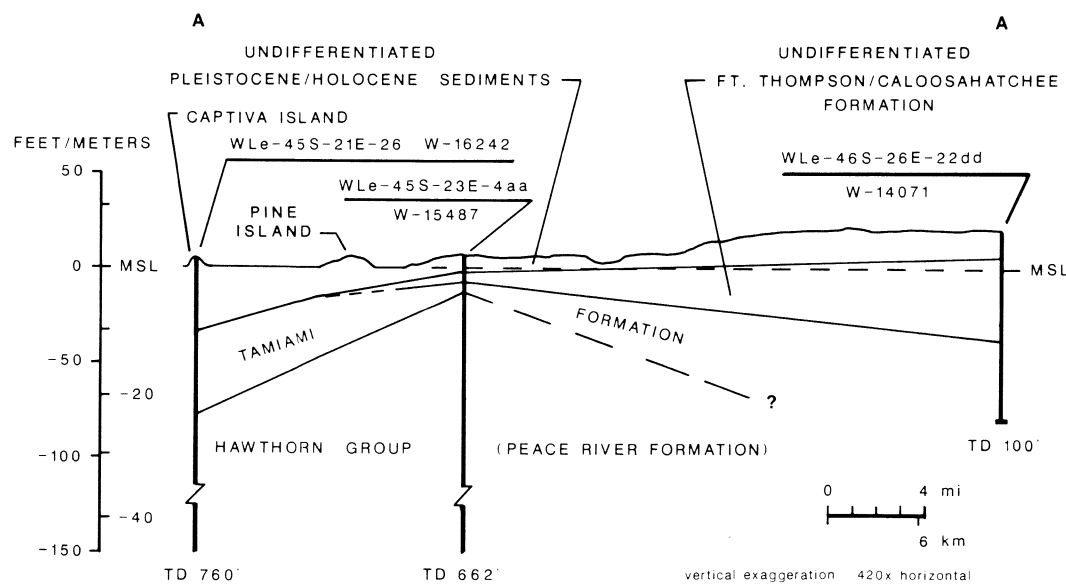


FIGURE 3b CROSS SECTION A-A'

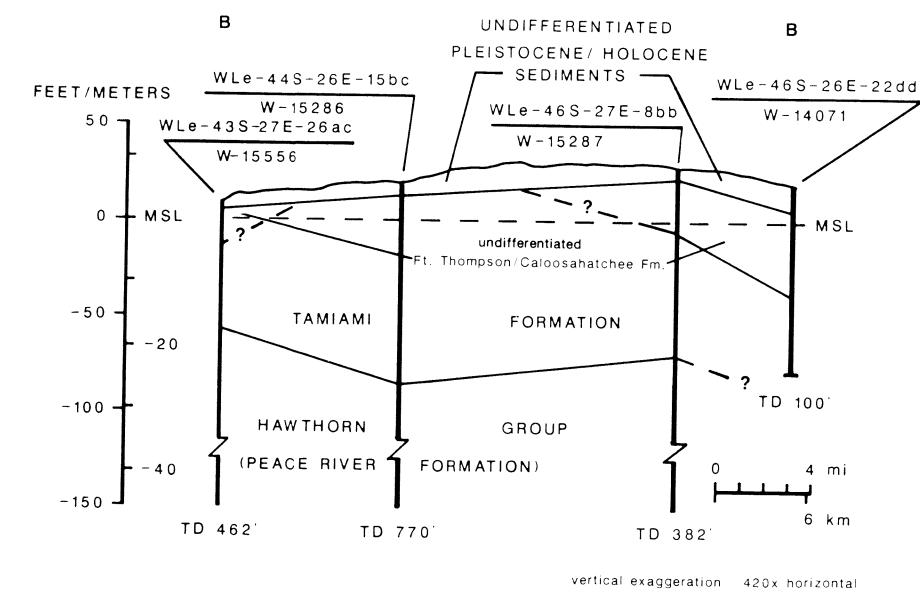


FIGURE 3c CROSS SECTION B-B'

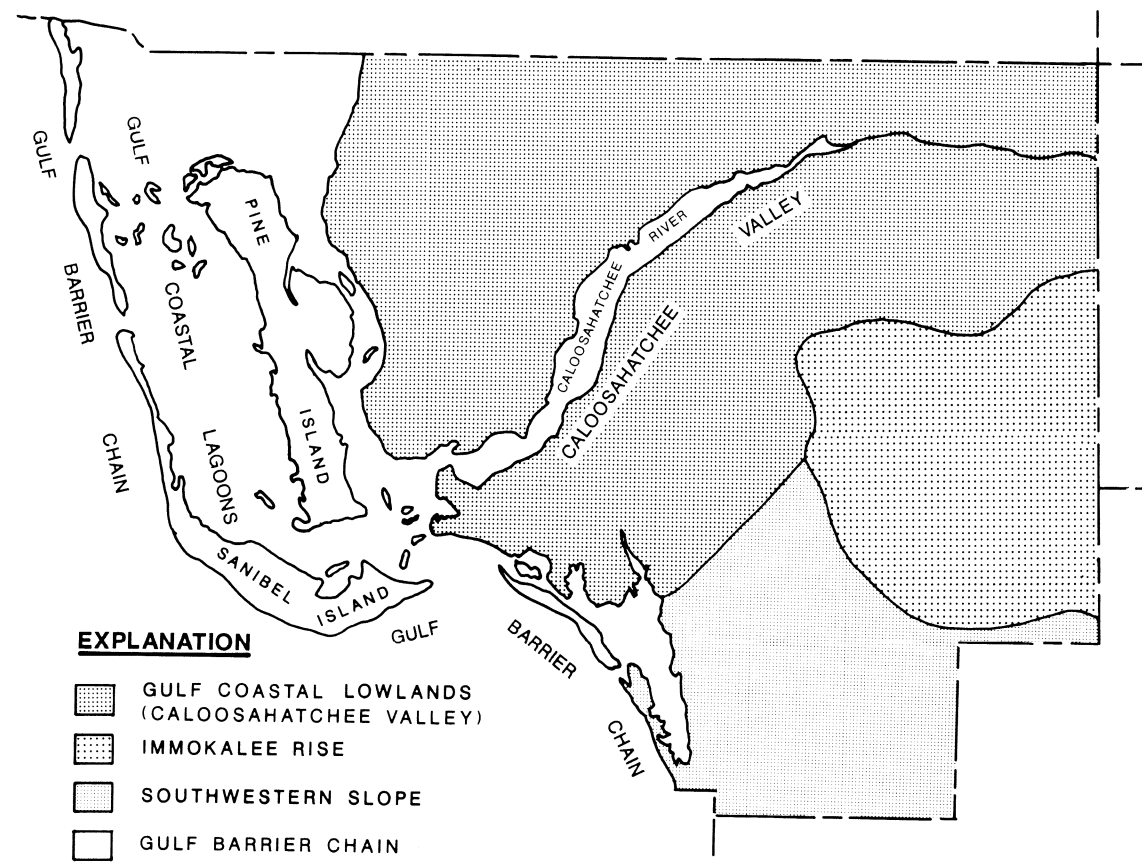


FIGURE 1 GEOMORPHOLOGY (from White 1970, and Lane 1980)

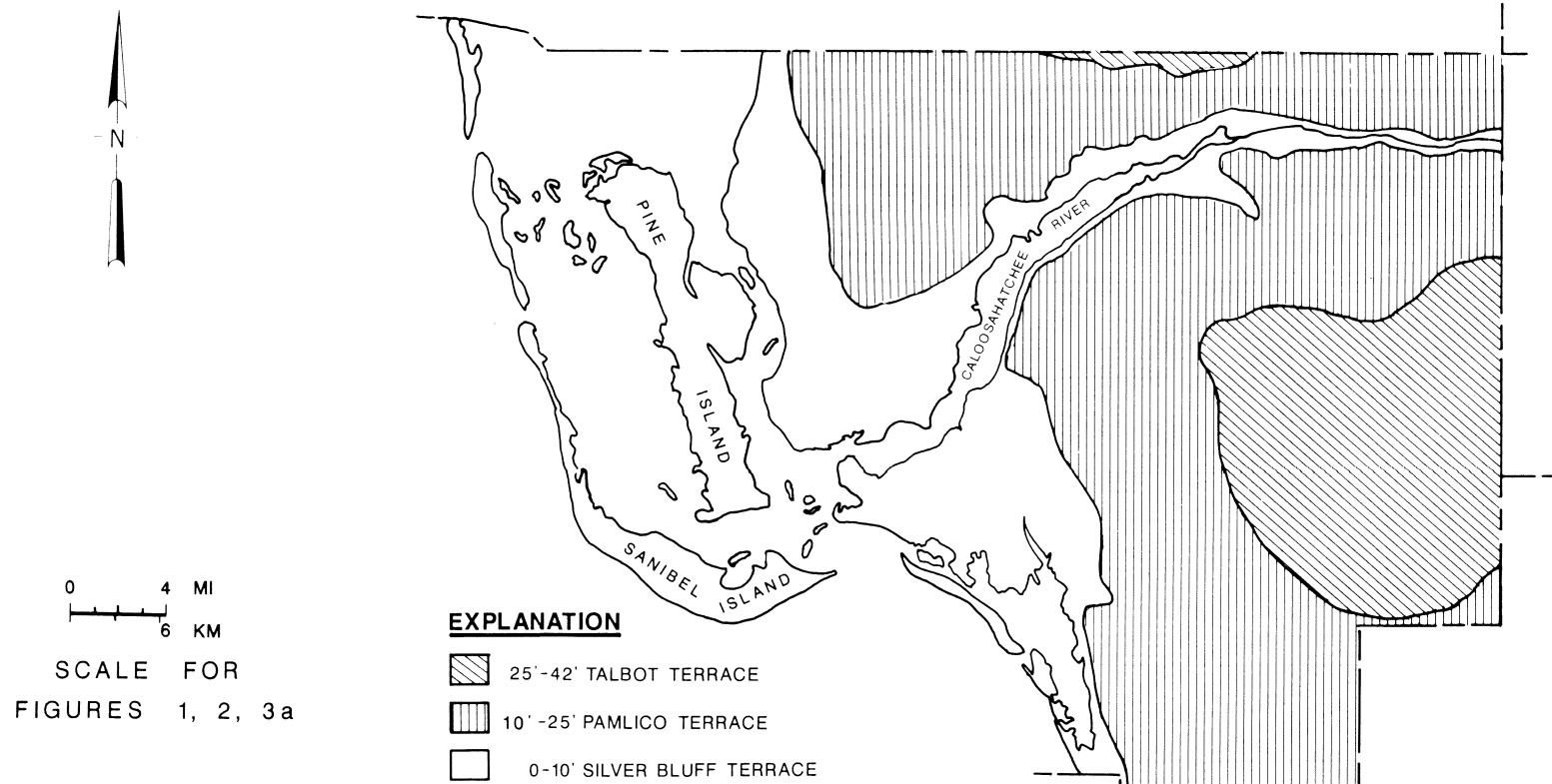
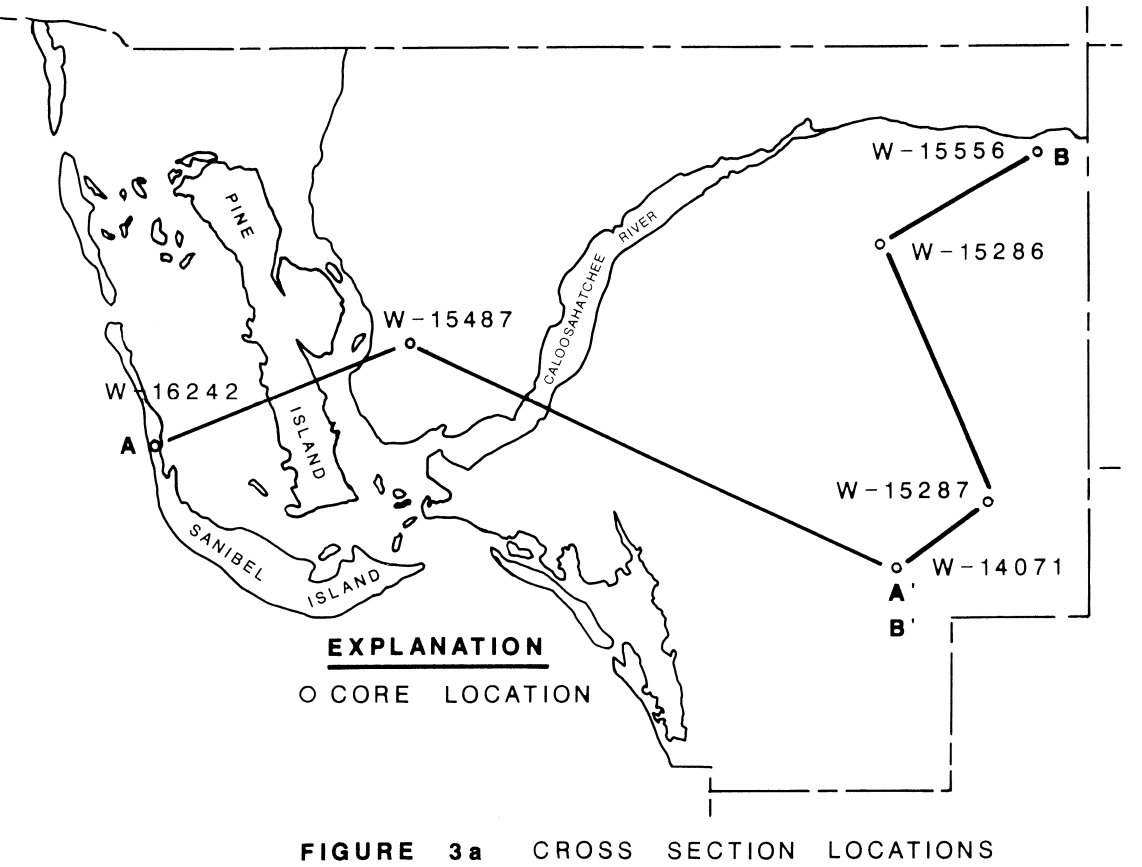
FIGURE 2 TERRACES AND SHORELINES
(modified from Healy 1975)

FIGURE 3a CROSS SECTION LOCATIONS

The well and quarry system used in this report uses the rectangular system of section, township and range for identification. The well or outcrop number consists of six parts: W for well or L for quarry, county abbreviation, the Township, Range, and Section, and the quarter/quarter location within the section.

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FLORIDA GEOLOGICAL SURVEY

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