

- Gibson, T. G., 1983. Key Foraminifera from upper Oligocene to lower Pleistocene strata of the central Atlantic Coastal Plain, p. 355-453, in Ray, C. E. (ed.), Geology and paleontology of the Lee Creek Mine, North Carolina, I. Smithsonian Contributions to Paleobiology, 53.
- Hazel, J. E., 1983. Age and correlation of the Yorktown (Pliocene) and Croatan (Pliocene and Pleistocene) Formations at the Lee Creek Mine, p. 81-199, in Ray, C. E. (ed.), Geology and paleontology of the Lee Creek Mine, North Carolina, I. Smithsonian Contributions to Paleobiology, 53.
- Hoffman, C. W., and Ward, L. W., 1989. Upper Tertiary deposits of northeastern North Carolina, p. 53-62, in Harris, W. B., Hurst, V. J., Nystrom, P. G., Jr., and Ward, L. W., Upper Cretaceous and Cenozoic geology of the southeastern Atlantic Coastal Plain. 28th International Geological Congress, Field Trip Guidebook T172, American Geophysical Union.
- Hunter, M. E., 1968. Molluscan guide fossils in late Miocene sediments of southern Florida. Transactions, Gulf Coast Association of Geological Societies, 18:439-450.
- Mansfield, C. W., 1931. Some Tertiary mollusks from southern Florida. Proceedings of the U. S. National Museum, 79(21), 12 p.
- Mansfield, C. W. 1939. Notes on the upper Tertiary and Pleistocene mollusks of peninsular Florida. Florida Geological Survey Bulletin 18, 75 p.
- Miller, William III, and DuBar, J. R., 1988. Community replacement of a Pleistocene *Crepidula* biostrome. Lethaia, 21:67-78.
- Olsson, A. A., and Petit, R. E., 1964. Some Neogene Mollusca from Florida and the Carolinas. Bulletins of American Paleontology, 47(217):509-574.
- Petuch, E. J., 1982. Notes on the molluscan paleontology of the Pinecrest beds at Sarasota, Florida with the description of *Pyrueella*, a stratigraphically important new genus (Gastropoda: Melongenidae). Proceedings of the Academy of Natural Sciences of Philadelphia, 134:12-30.
- Petuch, E. J., 1986. The Pliocene reefs of Miami: their geomorphological significance in the evolution of the Atlantic Coastal Ridge, southeastern Florida, U.S.A. Journal of Coastal Research, 2(4):391-408.
- Riggs, S. R., and Belknap, D. F., 1988. Upper Cenozoic processes and environments of continental margin sedimentation: eastern United States, p. 131-176, in Sheridan, R. E., and Grow, J. A., eds., The Geology of North America, Volume I-2, The Atlantic Continental Margin, U. S., Geological Society of America.
- Scott, T. M., 1988. The lithostratigraphy of the Hawthorn Group (Miocene) of Florida. Florida Geological Survey Bulletin 59, 148 p.
- Snyder, S. W., Mauger, L. L., and Akers, A. H., 1983. Planktonic Foraminifera and biostratigraphy of the Yorktown Formation, Lee Creek Mine, p. 455-481, in Ray, C. E. (ed.), Geology and paleontology of the Lee Creek Mine, North Carolina, I. Smithsonian Contributions to Paleobiology, 53.
- Ward, L. W., 1984. Stratigraphy of outcropping Tertiary beds along the Pamunkey River - central Virginia Coastal Plain, p. 11-77, in Ward, L. W., and Krafft, K., eds., Stratigraphy and paleontology of the outcropping Tertiary beds in the Pamunkey River region, central Virginia Coastal Plain. Guidebook for Atlantic Coastal Plain Geological Association 1984 field trip, Atlantic Coastal Plain Geological Association.
- Ward, L. W., 1989. Tertiary stratigraphy of the central Virginia Coastal Plain, p.63-90, in Harris, W. B., Hurst, V. J., Nystrom, P. G., Jr., and Ward, L. W., Upper Cretaceous and Cenozoic geology of the southeastern Atlantic Coastal Plain. 28th International Geological Congress, Field Trip Guidebook T172, American Geophysical Union.
- Ward, L. W., and Blackwelder, B. W., 1987. Late Pliocene and early Pleistocene Mollusca from the James City and Chowan River Formations at the Lee Creek Mine, p. 113-283, in Ray, C. E. (ed.), Geology and paleontology of the Lee Creek Mine, North Carolina, II. Smithsonian Contributions to Paleobiology, 61.

In Plio-Pleistocene Stratigraphy and Paleontology of South Florida. W.D.Allmon and T.M.Scott, eds. Southeastern Geological Society Annual Fieldtrip Guidebook. (1990)

STRATIGRAPHIC CORRELATION OF SEDIMENT FACIES WITHIN THE TAMIAMI FORMATION OF SOUTHWEST FLORIDA

Thomas M. Missimer, P.G.
Missimer & Associates, Inc.
428 Pine Island Road, S. W.
Cape Coral, Florida 33991

INTRODUCTION

A variety of definitions have been given to the Tamiami Formation in Southwest Florida. The informal name "Tamiami limestone" was given to the unit as observed in a series of sandy limestone outcrops occurring along the north side of U.S. 41 (Tamiami Trail) in Collier County (Mansfield, 1939). Detailed historic descriptions of the evolution of the Tamiami Formation definition are given in Hunter and Wise (1980), Missimer (1984), and Meeder (1987).

Both the top and the bottom of the unit, as well as the age, have been in dispute for the past 40 years. The top of the Tamiami Formation can be any one of a number of different lithologies, including limestone, sandstone, quartz sand, marl, shell beds, or clay. Most of the named members of the Tamiami Formation, such as the Ochopee Limestone and the Buckingham Limestone, are devoid of preserved aragonitic fossils. Because of the implied age difference between the members of the formation devoid of aragonitic shell and some differences in fossil assemblage, Olsson (1964, 1968) placed the Pinecrest beds stratigraphically above the Tamiami Formation. Although there are several recognized unconformities between various members of the Tamiami Formation, the Pinecrest beds or Pinecrest Sand Member should be contained within the Tamiami Formation. Therefore, the top of the formation may include any of the lithologies lying below the Caloosahatchee Formation, where present, or below the Fort Thompson Formation, where it lies unconformably on the Tamiami Formation.

The definition of the Hawthorn Group, as described in Missimer and Banks (1982), Missimer (1984), and Scott (1988), is utilized to establish the base of the Tamiami Formation. In Sarasota County, Charlotte County, and most of Lee County, the base of the Tamiami Formation occurs at the top of the first major green dolosilt/sand unit. In southern Lee County, there is a green dolosilt unit lying within the Tamiami Formation. In this area, the top of the underlying

Hawthorn Group occurs in a gray quartz sand unit. In Collier County, the contrast may be defined by the occurrence of either a quartz sand unit or a green dolosilt unit.

DESCRIPTION OF TAMIAMI FORMATION FACIES

Introduction

There are at least 9 facies of the Tamiami Formation that may be mapped on the basis of dominant lithology in Southwest Florida. The stratigraphic relationship of these units at a number of locations in Southwest Florida is shown in Figure 1. Many of the units vary in terms of thickness, at a given location. Therefore, the information presented in Figure 1 shows only the vertical stratigraphic positions at some general locations.

Pinecrest Sand Member

The Pinecrest Sand Member is derived from the "Pinecrest beds" informally described by Olsson (1964, 1968) for a faunal assemblage found near the 40-mile bend along U.S. 41 near the Collier - Dade county line. This name for the faunal assemblage was pre-dated by the description given by Tucker and Wilson (1932, 1933) for a similar faunal assemblage found near the village of Acline in Charlotte County. The lithology of the Acline and the original "Pinecrest beds" was aragonitic shell and quartz sand with a fine grain, green or gray-green matrix.

Deposits of Pinecrest fauna have been described in Sarasota by Petuch (1982) and Stanley (1986). Meeder (1987) described a reefal limestone facies containing Pinecrest fauna in Collier and Lee counties and he termed this unit the Golden Gate Member of the Tamiami Formation.

There is a problem with the definition of the Pinecrest fauna as a member of the formation. Presence of a faunal type does not define a sediment facies or specific lithic unit. Since the Pinecrest was originally defined as the Pinecrest Sand, in this paper, the lithology of the member is specially defined as a sand and shell unit. The "Acline fauna" of Charlotte County is considered to be part of the Pinecrest Sand Member.

Most members of a formation can be mapped over some significant size geographic area. The Pinecrest Sand Member, however, occurs in rather isolated, small areas separated by large distances. It is not continuous between areas where the section has been measured and described. For example, there are very isolated occurrences of the Pinecrest Sand Member in Charlotte County, along Alligator Alley in Collier County, in Dade County, and in a few areas north of the Big Cypress Indian Reservation in Hendry County. At many of the isolated

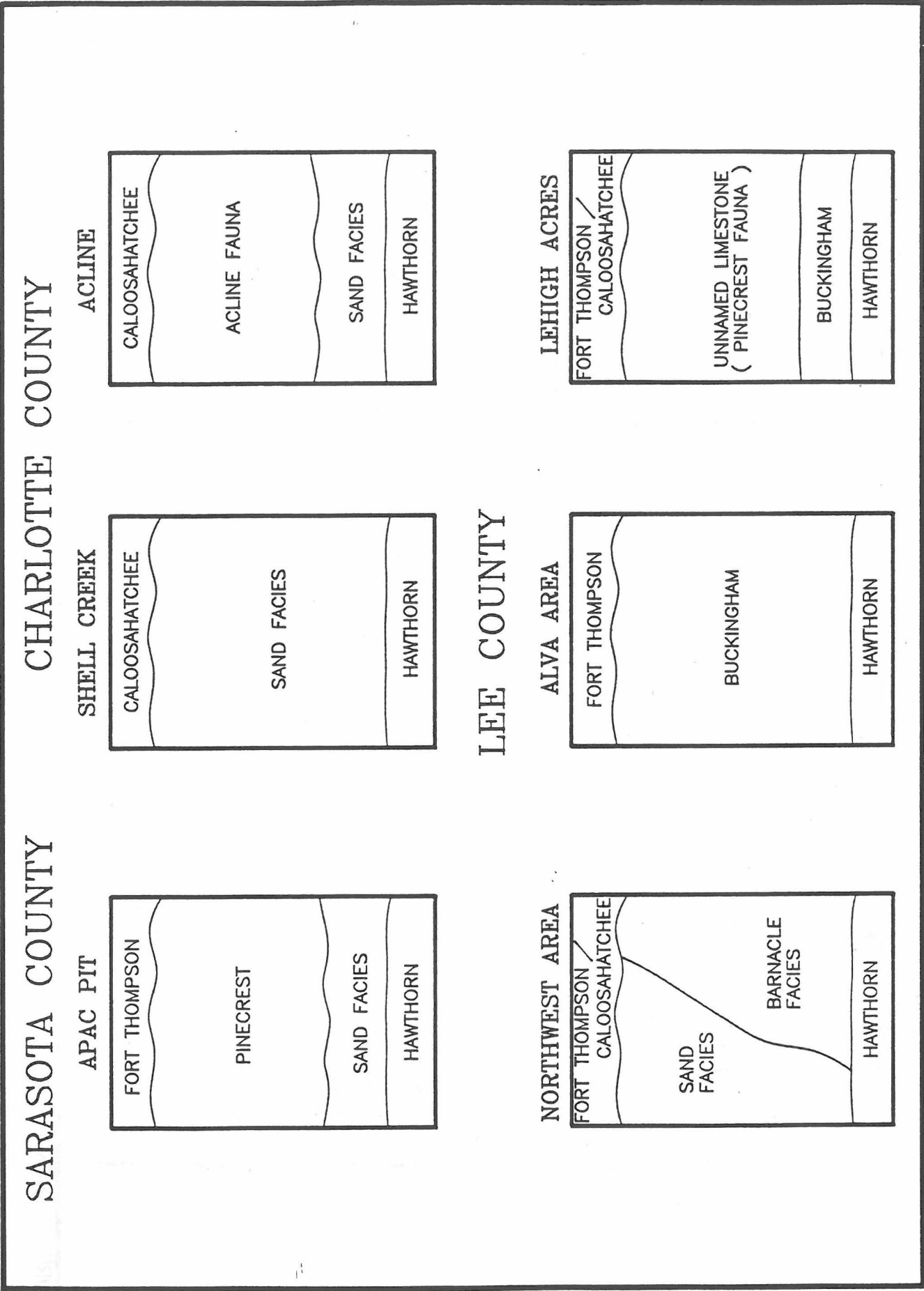


FIGURE 1. TAMIAMI FORMATION FACIES.

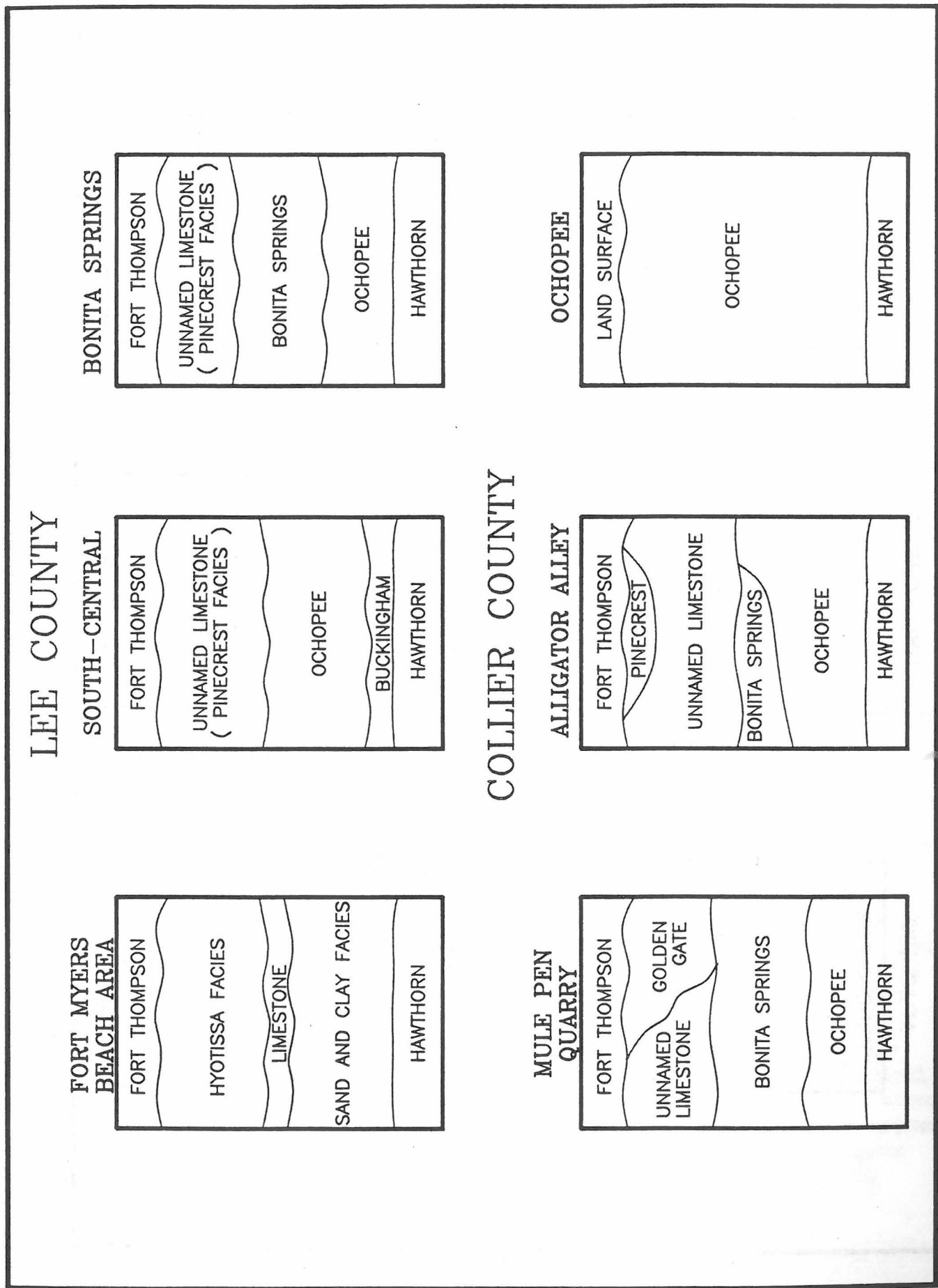


FIGURE 1. TAMAMI FORMATION FACIES.

occurrences of the Pinecrest Sand, it lies disconformably on another underlying Tamiami Formation member.

Unnamed Limestone Facies

A large area of southern and central Lee County and northern Collier County is underlain by a limestone unit that contains the Pinecrest fauna. This limestone is light gray to tan in color, contains only a small percentage of quartz sand and shells of only calcitic fossils. All or most of the aragonitic material has been dissolved, leaving mostly molds and casts. The limestone does contain a number of large oysters, particularly *Hyotissa haitensis* (Sowerby, 1850), barnacles, and pectens. The density of preserved calcite fossils increases to the north part of the facies in Lee County.

This limestone unit may be considered to be included as part of the Golden Gate Reef Member as defined by Meeder (1987). However, the preserved reefal material and aragonitic fossil assemblage described by Meeder does not occur uniformly in the limestone north of the Bonita Springs area of south Lee County. The corals are recrystallized, where present, and the mollusks are in molds and casts.

There is a distinctive disconformity between this unit and the underlying Buckingham Limestone Member in the Lehigh Acres area of north Lee County. In south-central Lee County, the limestone facies lies directly on top of the Ochopee Limestone Member.

Golden Gate Reef Member

A major work effort has been completed by Meeder (1987) on the Tamiami Formation. This investigation was oriented toward the mapping and faunal identification of reefal assemblages found in Collier and Lee counties. Sixteen rock types were identified of which fifteen occur within the Tamiami Formation. The reefal material described by Meeder (1987) does not occur uniformly over the area, and varies from a well-preserved state in the Golden Gate area of Collier County, where most of the coral and associated molluskan fauna are aragonitic, to a lesser state of perservation north in Lee County, where the corals are calcitic and recrystallized.

Meeder (1987) did not formally define the Golden Gate Reef Member in terms of the stratigraphy and the relationships with other major lithic units. Therefore, the Golden Gate Reef Member is considered to be within the top of the Unnamed Limestone Facies. It differs in lithology from the Pinecrest Sand Member and is a carbonate rather than clastic unit.

Bonita Springs Marl Member

The Bonita Springs Marl Member was informally suggested by Missimer (1984). This unit can be mapped over about a one hundred square mile area in southwest Lee County and northwest Collier County. It is a green dolosilt unit in the vicinity of Bonita Springs, but contains a large variety of different lithologies all of which contain a lime mud or dolosilt matrix. In certain areas, the lithology of this unit is similar to the uppermost part of the Peace River Formation (Hawthorn Group). It is devoid of micro-fossils, but does contain several barnacles which commonly occur in a number of the Tamiami Formation facies.

If this unit did not lie directly between the Unnamed Limestone Facies and the Ochopee Limestone Member, it probably would be mapped as part of the Peace River Formation. However, the similarity in lithology is the probable result of the incorporation of reworked Peace River Formation dolosilt being deposited into a shallow embayment occurring in the Bonita Springs area. The lithology and color of the "marl" more closely resembles modern carbonate depositional environments, such as Florida Bay, in areas south of Bonita Springs.

Hyotissa Facies

Hyotissa haitensis is a common fossil occurring in most of the Tamiami Formation facies. However, there is an area located in western-central Lee County, where Hyotissa shells form over 60% of the section. This area covers 20 to 40 square miles and the thickness of the unit reaches from 5 to 12 feet.

The Hyotissa facies contains about 60 to 75% oyster shells, 5% Pecten shells, 5 to 20% quartz sand and phosphate modules, and 10 to 20% lime mud and clay. Only calcitic fossils occur within the unit and there are few, if any, molds and casts of aragonitic fossils. The matrix of the unit is similar to the Buckingham Limestone Member.

Ochopee Limestone Member

The "Ochopee Limestone Member" was suggested by Hunter (1968). It was described as a "light gray to white, hard, sandy limestone (a calcarenite) containing abundant identifiable mollusk molds and well preserved pectens, oysters, barnacles, and echinoids". The Ochopee Limestone Member is a major facies of the Tamiami Formation and can be mapped beneath most of Collier County and parts of Lee, Hendry, Dade, Monroe, and Broward counties. It occurs at land surface in Collier County along the Tamiami Trail (U.S. 41), where Mansfield (1939) first described the Tamiami Formation.

A distinguishing characteristic of the Ochopee Limestone Member is the occurrence of fine to very fine quartz sand within the unit. The percentage of sand

in the member can range from 5 to 80% depending upon the location and depth. Commonly, the percentage of quartz sand increases with depth.

Sand Facies

A large area of coastal Charlotte and Lee counties is underlain by the Sand Facies of the Tamiami Formation. The lithology at a given location can vary greatly, but the common characteristic is a matrix of medium to fine quartz sand. This lithology was described by DuBar (1962) and was illustrated in Hunter (1968).

The Sand Facies of the Tamiami Formation was directly observed in several dewatered pits located along Burnt Store Road in Lee and Charlotte counties and in various locations within Cape Coral in Lee County. There are no preserved aragonitic fossils found in this unit. The most common calcitic fossils found are barnacles, oysters, (Hyotissa haitensis, Oytrea disparilis), pectens (Argopecten eboreus, different varieties), bryozoans, and the gastropod Ecphora. Bedded sandstone and very thin limestone units are common with this section. At a number of locations the Sand Facies is a partially lithified barnacle shell harsh and sand unit.

Buckingham Limestone Member

The Buckingham Limestone Member was originally described by Mansfield (1939), and was informally defined as a member of the Tamiami Formation by Hunter (1968). The description given by Hunter (1968) is "Light gray to white soft calcareous clay (a calcilitite) that weathers to a buff colour. It contains some quartz sand, a few bone fragments and shark teeth, and few grains of brown phosphate. Poorly preserved fossil molds, and well preserved pectens, oysters, barnacles, echinoids, etc. are present". A series of cores taken through the unit in the vicinity of the W.P. Franklin Dam in Lee County show that the unit also contains a large quantity of rock fragments, quartz sand, phosphatic pebbles, and reworked green dolosilt.

A large quantity of the sediment contained within the Buckingham Limestone Member is reworked from the underlying Peace River Formation. It does contain a peletic matrix of lime mud and clay minerals, but over 70% of the sediment may be considered to be clastic or rock fragments at many locations. The member has a very high concentration of radioactive materials (phosphate nodules) and can be easily distinguished from the underlying Peace River Formation dolosilt using gamma ray logs.

Tan Clay and Sand Facies

At a number of locations in central, coastal Lee County, a tan clay and sand facies underlies either the Hyotissa Facies or the Unnamed Limestone Facies. This unit lies disconformably beneath the overlying Tamiami Formation facies with a very thin calcrete at the top of the unit. The quartz sand within the unit contains a number of concretions, some containing interior sparrey calcite crystals. Some of the quartz sand is rather coarse. The phosphatic material contained within the unit is mostly sand-sized.

CORRELATION OF FACIES

There are a large number of different sediment facies that lie within the Tamiami Formation in Southwest Florida. The relative stratigraphic positions of the described units at various locations has been shown in Figure 1. Of the nine different stratigraphic units described, only 1 to 4 occur in a vertical stratigraphic section at any given locality. Therefore, it is difficult to correlate the units on a relative age basis. Fortunately, there are some observed disconformities lying between some of the members.

Based on the observed stratigraphic positions, the location of disconformities, the preservation of fossil material, and other criteria, the implied age relationships of the members and facies is given in Figure 2. A plan view of the occurrence of the uppermost Tamiami Formation unit encountered in Lee County is given in Figure 3. The Buckingham Limestone is the lowermost Tamiami Formation member based on the character of the sediment and the relative stratigraphic position of the unit at various locations. It is the probable age equivalent to the Clay and Sand Facies and perhaps to all or part of the Sand Facies. The Hyotissa Facies lies as an equivalent of the upper part of the Buckingham or immediately above it. The Ochopee Limestone lies between the units containing the Pinecrest fauna and the underlying Buckingham Limestone. The upper part of the Sand Facies is probably equivalent to the Ochopee Limestone. Where the Unnamed Limestone (Pinecrest fauna) lies directly on Buckingham Limestone, there is a distinct disconformity. All of the upper units containing the Pinecrest fauna are quite close in age, but the units containing well-preserved aragonitic shell and coral are probably slightly younger than the other units.

The lithology of the uppermost occurrence of the Tamiami Formation in Lee County (Figure 3) shows some interesting relationships. The areas delineated on Figure 3 are only approximate, and there are some deviations within the areas shown. A large part of the Caloosahatchee River valley does not contain any Tamiami Formation sediments. The oldest Tamiami Formation unit, the Buckingham Limestone Member, lies near the surface only in the northeast part of

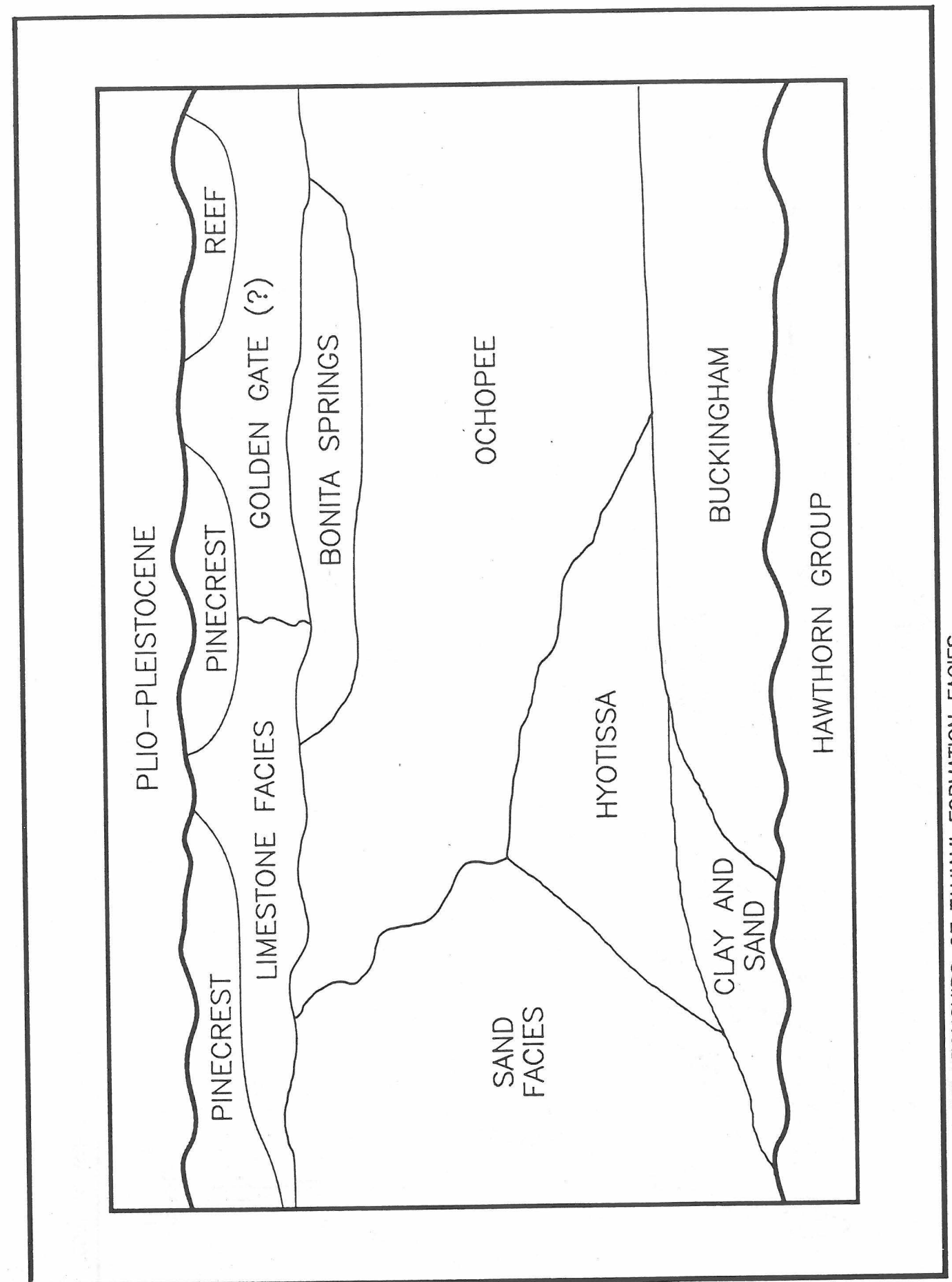


FIGURE 2. AGE RELATIONSHIPS OF TAMIAMI FORMATION FACIES.

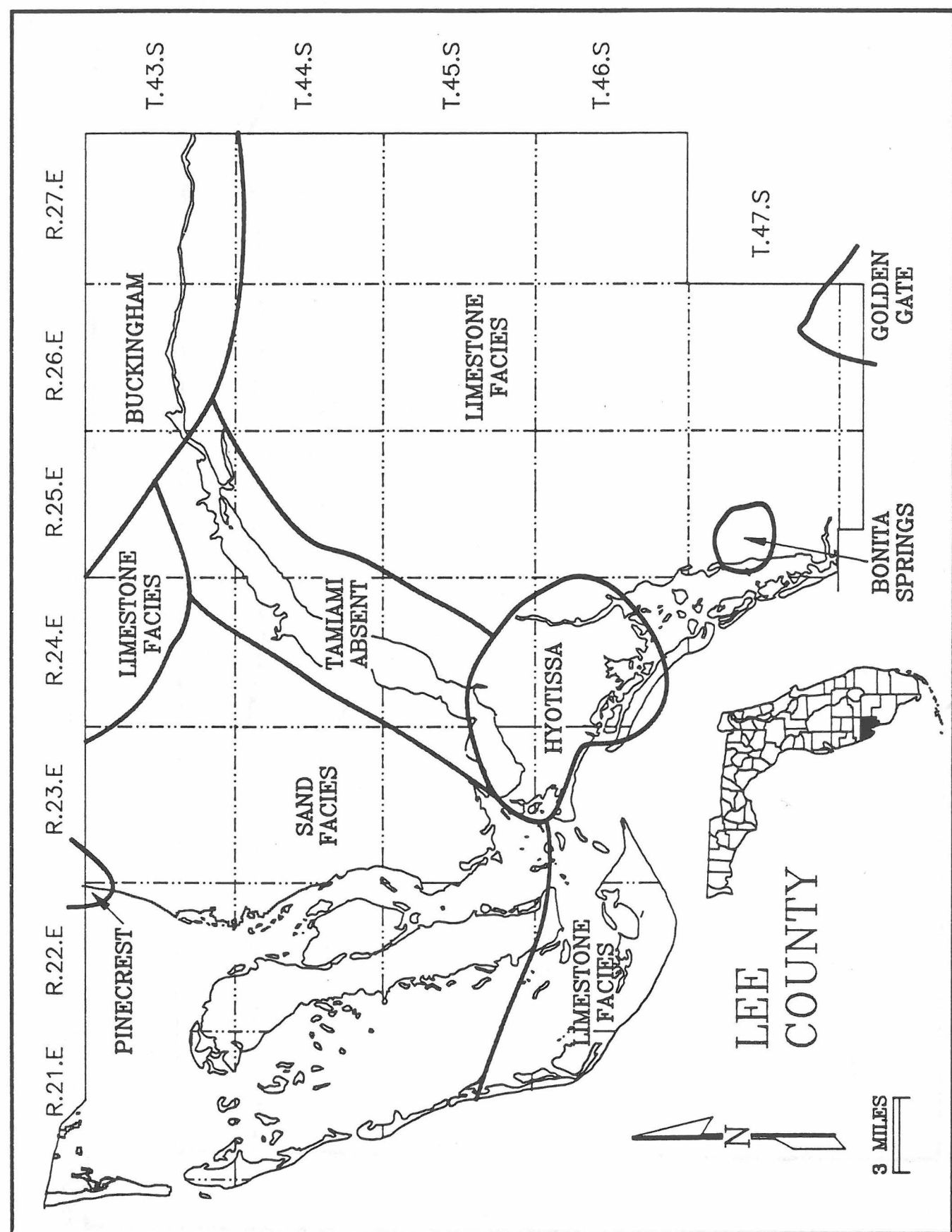


FIGURE 3. MAP SHOWING THE UPPERMOST TAMIAMI FORMATION FACIES IN LEE COUNTY.

the county. The more clastic facies lie mostly adjacent to the existing coastal area. Occurrences of the Pinecrest Sand or Golden Gate Reef Members are limited to isolated areas (there are the areas with preserved aragonitic shell).

REFERENCES

- DuBar, J. R., 1962, Neogene biostratigraphy of the Charlotte Harbor area in southwestern Florida: Florida Geological Survey Bull. No. 43., 83 p.
- Hunter, M. E., 1968, Molluscan guide fossils in Lake Miocene sediments of southern Florida: Gulf Coast Assoc. Geol. Societies Transactions, v. 18, p. 439-450.
- Hunter, M. E., and Wise, S. W., Jr., 1980, Possible restriction and redefinition of the Tamiami Formation of South Florida: Points for further discussion in P. J. Gleason, ed., Water, Oil, and the Geology of Collier, Lee, and Hendry counties: Miami: Geological Society Field Trip, 1980, p. 41-44.
- Mansfield, W. C., 1939, Notes on the Upper Tertiary and Pleistocene mollusks of peninsular Florida: Florida Geological Survey of Bulletin 18, 75 p.
- Meeder, J. F., 1987, The paleoecology, petrology, and depositional model of the Pliocene Tamiami Formation, Southwest Florida (with special reference to corals and reef development: Ph.D. Dissertation, University of Miami, Coral Gables, Florida, 748 p.
- Missimer, T. M., 1978, The Tamiami Formation - Hawthorn Formation contact in Southwest Florida: Florida Scientist, v. 14, p. 31-39.
- Missimer, T. M., 1984, The geology of South Florida: A summary in *Environments of South Florida, Present and Past II* (P. J. Gleason, editor): Miami Geological Society, Coral Gables, Florida, p. 385-404.
- Missimer, T. M., and Banks, R. S., 1982, Miocene cyclic sedimentation in western Lee County, Florida in *Miocene Geology of Southeastern United States*: Florida Bureau of Geology Spec. Pub. 25, p. 285-299.
- Olsson, A. A., 1964, Geology and stratigraphy of southern Florida in Olsson and Petit, some neogene mollusca from Florida and the Carolinas: Bull. Am. Paleontology, v. 47, No. 217, p. 509-574.

- Olsson, A. A., 1968, A review of late Cenozoic stratigraphy of South Florida in R. D. Perkins, Compiler, Late Cenozoic stratigraphy of southern Florida - a reappraisal: 2nd Annual Field Trip, Miami Geological Society, p. 66-82.
- Parker, G. G., Ferguson, G. E., and Love, S. K., 1955, Water resources of southeastern Florida: U.S. Geological Survey Water - Supply Paper 1255, 965 pp.
- Petuch, E. J., 1982, Notes on the molluscan paleoecology of the Pinecrest beds at Sarasota, Florida with the description of *Pyruella*, a stratigraphically important new genus (Gastropoda: Melongenidae): Proceedings of the Academy of Natural Sciences of Philadelphia, v. 134, p. 12-30.
- Scott, T. M., 1988, The lithostratigraphy of the Hawthorn Group (Miocene) of Florida: Florida Geological Survey, Bull. No. 59, 148 p.
- Stanley, S. M., 1986, Anatomy of a regional mass extinction: Plio-Pleistocene decimation of the western Atlantic bivalve fauna: *Palaios*, v. 1, p. 17-36.
- Tucker, H. I., and Wilson, D., 1932, Some new and otherwise interesting fossils from the Florida Tertiary: *Bull. Am. Paleontology*, v. 18, p. 39-82.
- Tucker, H. I., and Wilson, D., 1933, A second contribution to the Neogene paleontology of South Florida: *Bull. Am. Paleont.*, v. 18, No. 66, 20 pp.

DIAGNOSTIC MOLLUSKS FROM THE APAC PIT, SARASOTA, FLORIDA

Lauck W. Ward
Virginia Museum of Natural History
Martinsville, VA 24112

Introduction

This report deals with a few of the biostratigraphically significant mollusks collected from the extremely fossiliferous beds at the APAC Pit, Sarasota, Florida on March 19, 1990. The various beds [Petuch's (1982) beds 1-11] were identified by Warren Allmon for the author and care was taken to collect only within the bounds of those beds. Diagnostic mollusks identified for this study are listed in Table 1, as well as their distribution within the APAC Pit and in significant stratigraphic units in Virginia and South Carolina (see Figure 1). The beds are discussed in chronologic order from oldest to youngest. The technique employed is to use the biostratigraphically useful mollusks found here to correlate to stratigraphically known and better understood units in Virginia and South Carolina.

"Bed 12"

"Bed 12" is a unit stratigraphically lower than Petuch's (1982) beds 1 through 11. It is a dark gray-green, highly phosphatic quartz sand interbedded with silt-clays. The molluscan fauna is limited, as is the outcrop area of the unit. The bed is exposed in the bottom of the APAC Pit but the sample discussed here came from the nearby Quality Aggregates Pit (Phase 1).

Aragonitic mollusks are present only as poor molds in "Bed 12" and, as a result, only one species, *Cyclocardia granulata*, was identified (Table 1). The calcitic mollusks were also somewhat weathered, but among them there appears to be good specimens of *Carolinapecten eboreus watsonensis*, *Chesapecten septenarius*, and *Ostrea raveneliana*. This meager assemblage suggests a biostratigraphic correlation with the Rushmere Member of the Yorktown Formation in Virginia and the basal Raysor Formation in South Carolina. Only *Cyclocardia granulata* occurs in units older than the Rushmere; its first occurrence is in the Sunken Meadow Member of the Yorktown Formation (lower Pliocene). *Chesapecten septenarius* is not known stratigraphically above the Rushmere.

The Rushmere is considered to be early late Pliocene in age (Ward and Huddlestun, 1988). The small assemblage suggests a Virginian provincial setting or mild temperate conditions.

Bed 11

Aragonitic mollusks are moderately well-preserved in Bed 11 and a number of diagnostic forms are present (Table 1). A number of species make their first appearance in the Rushmere Member of the Yorktown Formation. Among those are *Chesapecten septenarius*, *Ostrea raveneliana*, *Marvacrassatella undulatus*, *Mulinia congesta*, *Carditamera arata*, *Contraconus adversarius*, *Plicatula marginata*, and *Granoarca propatula*. *Chesapecten septenarius*, *M.*