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LITHOLOGIC VARIATION IN THE MIAMI LIMESTONE OF FLORIDA

By

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ABSTRACT

The six lithofacies characteristic of the oolitic or pelletal upper Pleistocene Miami Limestone of south peninsular Florida are: ooid calcarenite (type), oomoldic-recrystallized limestone (modified type), calcirudite (molluskan, bryozoan or foraminiferal), breccia (intraformational or basal), quartz sand (unconsolidated to poorly-consolidated) or sandstone (well-consolidated), and (very minor) microsparry-coralline limestone. Ooid calcarenite is the dominant lithology in the Miami Limestone along the Atlantic Coastal Ridge of southeastern Dade County (from the Miami River south-southwest to the vicinity of Florida City) and in the Lower Keys of southern Monroe County. Oomoldic-recrystallized lithologies occur predominantly in portions of Broward, southeastern Palm Beach, and western and northern Dade Counties. Oolitic calcirudite lithofacies occur both to the north and west of the Atlantic Coastal Ridge in southeastern Dade County. Type ooid calcarenite interfingers with molluskan calcirudite in the Atlantic Coastal Ridge in northern Dade County and to the north. To the west of the ridge in Dade County and into mainland Monroe and southeastern Collier Counties, ooid calcarenite interfingers with bryozoan calcirudite which grades into molluskan and foraminiferal calcirudite. Intraformational breccia occurs very locally in the type area and basal breccia occurs discontinuously in Broward, north-central and western Dade, and southeastern Palm Beach Counties. Quartz sand or sandstone lithofacies occurs in Broward County and southeastern Palm Beach County. Microsparry-coralline lithofacies occurs only in the Lower Keys, southern Monroe County, and in extreme southeastern Dade County.

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INTRODUCTION

Upper Pleistocene Miami Limestone generally consists of abundantly oolitic and pelletal limestone. The type area of the Miami Limestone occurs along the Atlantic Coastal Ridge in the city of Miami, along the Silver Bluff scarp to the south-southwest of Miami, and along the Miami River (Sanford, 1909; Puri and Vernon, 1964). All lithologies included in the Miami Limestone lithostratigraphic unit of this report contain either ooids or pellets (or both) in some recognizable form and are physically continuous with or in some way correlatable with the type oolitic and pelletal limestone occurring in this area.

In the present study, oolitic or pelletal lithologies characteristic of the Miami Limestone were identified (Figure 1) in most of Dade County (excluding the northwest corner and beneath the southern and central portions of the barrier island of Miami Beach); in southern Broward County (excluding the southwest corner); in eastern Broward County (from the Atlantic coast westward to the eastern boundary of the Everglades Wildlife Management Area); in southeastern Palm Beach County (on the mainland westward to the eastern boundary of the Loxahatchee National Wildlife Refuge, and as two thin, narrow tongues to the north as far as Boynton Beach on the east and directly west of West Palm Beach on the west); in eastern and southern mainland Monroe County (to the west along the Loop Road, S.R. 94, to the vicinity of Pinecrest); in southern Monroe County (Lower Keys); and in southeastern Collier County (along the Tamiami Canal west to the vicinity of Monroe Station). (The Miami Limestone also probably occurs along the floor of Florida Bay in southern Monroe County; however, no outcrops, exposures, well-cuttings, nor cores were available from Florida Bay, and the Miami was not examined in that area for this study. Additionally, the occurrence of the Miami Limestone may extend to the west-southwest beyond Key West, but again, no samples were available for analysis.)

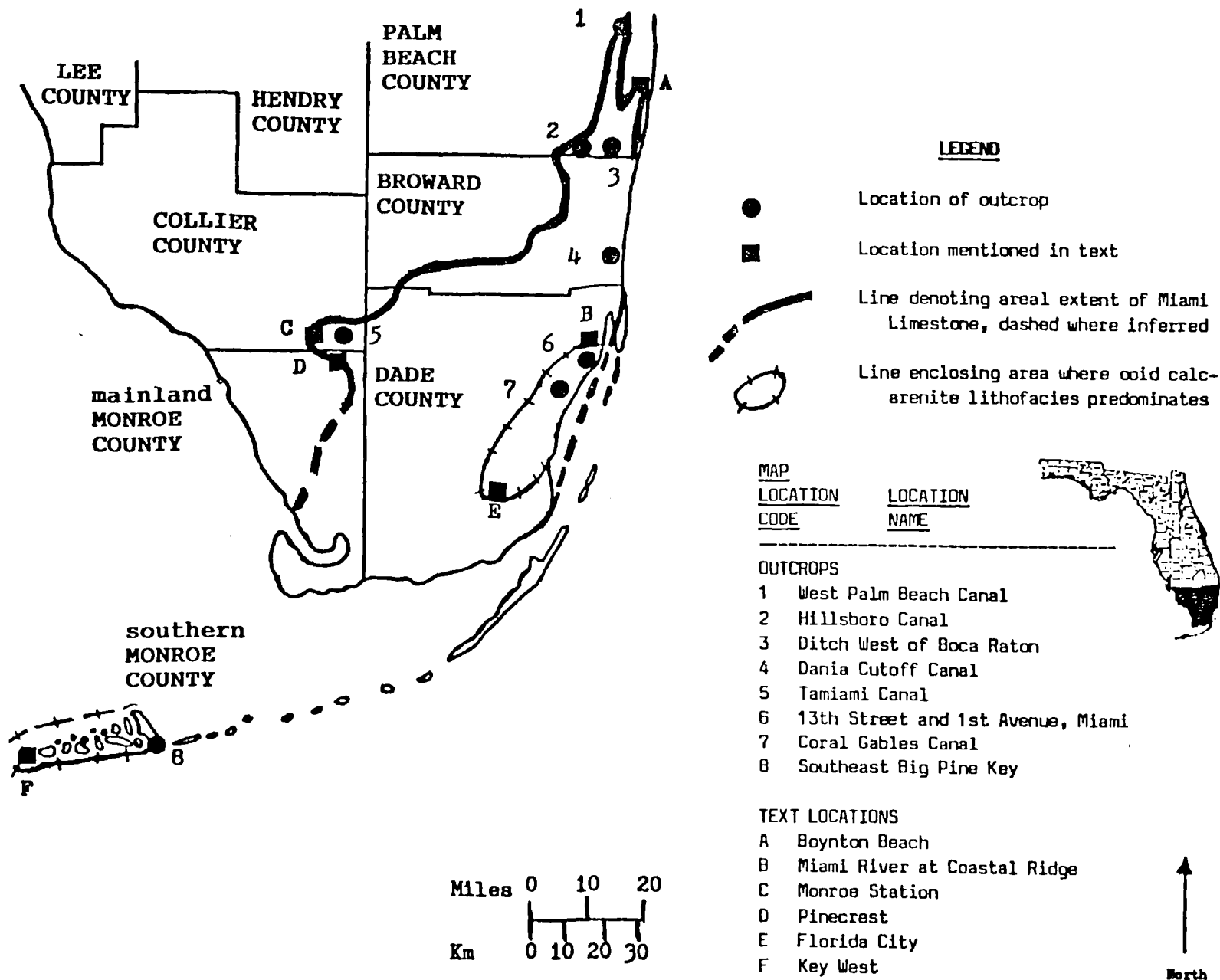
UNDERLYING UNITS

Figure 2 shows the distribution of stratigraphic units which occur subjacent to the Miami Limestone. The Miami Limestone is underlain by the molluscan coquina and shelly quartz sandstone of the upper Pleistocene Anastasia Formation in the extreme eastern portions of Broward and southeastern Palm Beach Counties. The Miami is underlain by the upper Pleistocene Fort Thompson Formation (sparsely- to moderately-shelly limestone and quartz sand) in the central portions of Broward County, southeastern Palm Beach County, and all of Dade County. The upper Pleistocene Key Largo Limestone (massive coralline limestone) underlies the Miami in the Lower Keys of southern Monroe County. The Pliocene Tamiami Formation (moldic to unfossiliferous, variably sandy limestone) underlies the Miami in southeastern Collier and eastern mainland Monroe Counties.

METHODS

For this study, 64 outcrops of the Miami Limestone were visited, examined, collected,

Figure 1. Map showing study area, extent of Miami Limestone, outcrop locations, locations mentioned in text, and area where type ooid calcarenite lithofacies predominates.



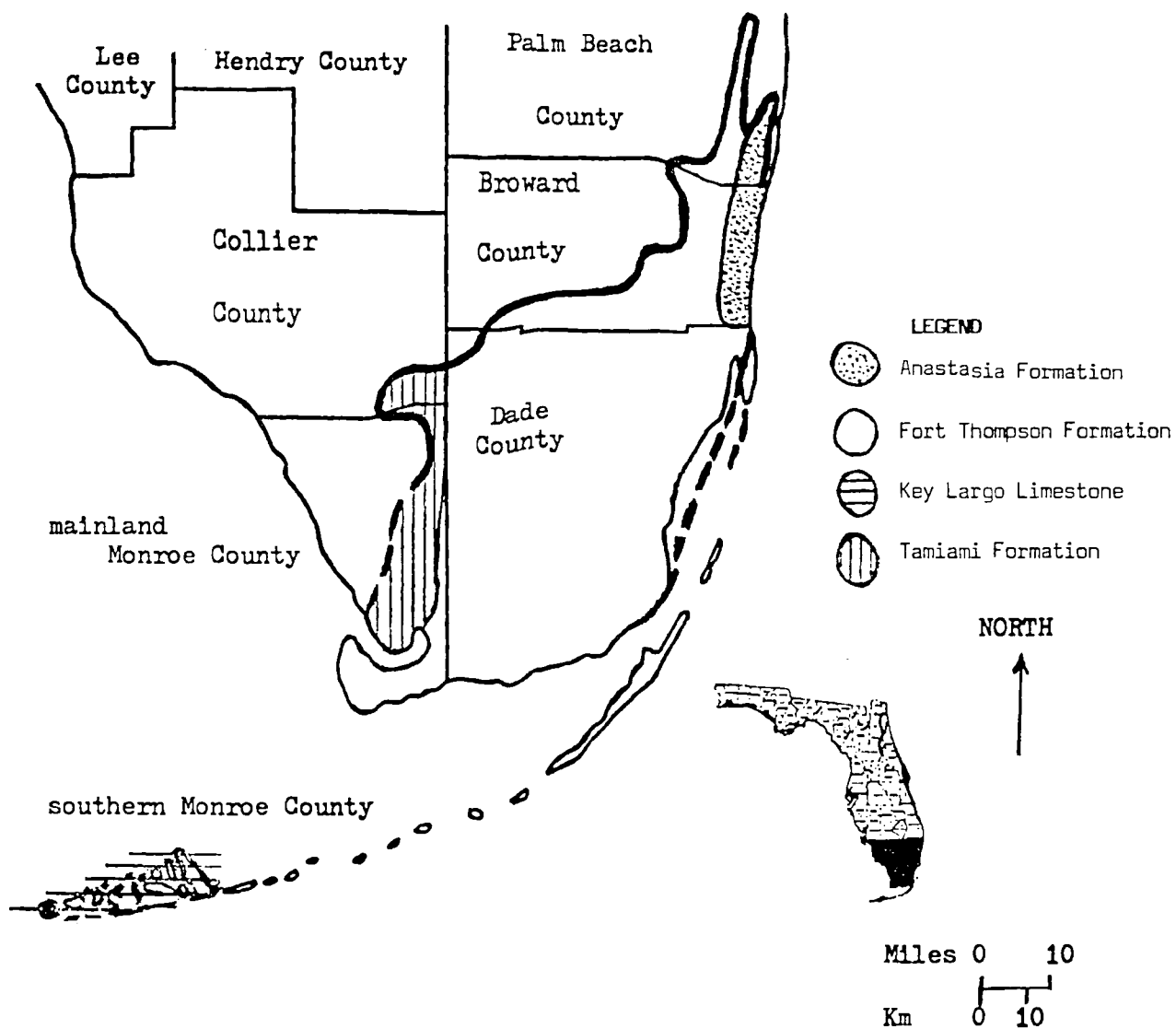


Figure 2. Subcrop map of the Miami Limestone.

sketched and lithologically described in a bed-by-bed manner (see Appendix, Part 1). These sections exhibited between 6 inches and 19 feet of Miami Limestone, and were located in Dade (18 exposures), Palm Beach (18 exposures), Monroe (12 exposures), Broward (9 exposures), and Collier (7 exposures) Counties. Forty-two Florida Geological Survey (FGS) cores of the Miami Limestone were examined from boreholes in Dade (26 cores), Broward (13 cores), Palm Beach (2 cores), and Monroe (1 core) Counties. In addition, 133 sets of FGS well-cuttings which contained recognizable Miami Limestone were examined from wells located in Dade (55 wells), Broward (47 wells), Palm Beach (27 wells), Monroe (3 wells), and Collier (1 well) Counties. Part 2 of the Appendix lists wells from which cores and cuttings were examined. Thus, the Miami Limestone was studied at a total of 239 locations in the five counties of its occurrence. Figure 3 provides a key to the lithologic symbols used in the remaining figures in this report.

LITHOFACIES

Six oolitic or pelletal lithofacies can be identified in the Miami Limestone: ooid calcarenite, oomoldic-recrystallized limestone, calcirudite, breccia, quartz sand or sandstone, and microsparry-coralline limestone.

Ooid Calcarenite

The ooids characteristic of the ooid calcarenite lithofacies (and generally of the entire Miami unit) consist of very fine to coarse sand size, spherical carbonate grains concentrically laminated around a silt size to fine sand size nucleus. In Dade, mainland and southern (the Lower Keys) Monroe, and southeastern Collier Counties, calcium carbonate nuclei are most common, whereas in Broward and southeastern Palm Beach Counties, very fine to fine quartz sand grain nuclei also occur.

The pellets characteristic of the Miami Limestone lack nuclei and concentric laminae, and also range from very fine to coarse sand size. In shape, they are spherical and ooid-like to ellipsoidal to conspicuously elongated and fecal-pellet-like. Pellets are most common in the Miami west of the Atlantic Coastal Ridge in Dade County and in mainland Monroe and southeastern Collier Counties; however, even the type oolitic limestone in the city of Miami contains scattered pellets as well as abundant ooids.

In the ooid calcarenite lithofacies, both ooids and pellets are very poorly- to very well-consolidated by calcium carbonate in several forms, including: very soft, unrecrystallized to partially recrystallized, clay- to silt-size calcilutite; hard, recrystallized, translucent to transparent, cryptocrystalline calcite; very hard, finely recrystallized microspar; or very hard, very finely recrystallized micrite.

The ooid calcarenite lithofacies may be cross-bedded, burrowed or massive and unbedded. The facies locally contains scattered unaltered mollusks and very low (less than 1%) to moderate (up to 15%) amounts of very fine to coarse quartz sand.



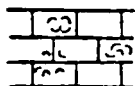
ooid calcarenite, all spacings



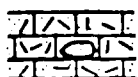
molluskan calcirudite, all spacings
(oolitic, Donax sp. or Chione
cancellata)



sandy (quartz) molluskan calcirudite
(oolitic)



thin molluskan calcirudite lenses
in ooid calcarenite



foraminiferal (Archaias sp.) calci-
rudite with quartz sand and sand-
stone breccia (oolitic)



breccia (oolitic)



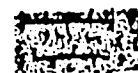
breccia with quartz sand
(oolitic)



oomoldic recrystallized facies with
variable quartz sand and mollusk
molds



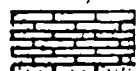
shelly quartz sand or sandstone,
unburrowed (oolitic)



burrowed quartz sandstone
(oolitic)



massive calcareous quartz sand-
stone, varies to limestone
(oolitic)



massive very finely recrystallized
limestone (nonoolitic)

Figure 3. Key to the lithologic patterns used in the figures of this report.

Ooid calcarenite is the type lithology present in the Atlantic Coastal Ridge of southeastern Dade County within the city of Miami. Ooid calcarenite also extends from Big Pine Key to Key West in the Lower Keys, southern Monroe County (Figure 1).

Figure 4 shows the section diagram obtained from the thickest exposure of Miami Limestone which consists almost exclusively of type ooid calcarenite, located in the south wall of the Coral Gables Canal near the intersection of LeJeune Road (SW 42nd Avenue) and Sunset Drive (SW 72nd Street) in Coral Gables, Dade County (Township 54 South, Range 41 East, Section 29, southwest quarter of southeast quarter). Beds 1-5, 7 and 10-14 consist of cross-bedded or burrowed (bed 1) ooid calcarenite, and beds 6 and 8-9 consist of very thinly-bedded Donax sp. molluskan calcirudite.

Oomoldic-Recrystallized Limestone

This lithofacies consists of slightly sandy (< 1% quartz) to very sandy (up to 49% quartz), well- to moderately well-consolidated, variably ooid- or pellet-moldic, recrystallized microspar, micrite or cryptocrystalline calcite. The term oomoldic was used by Hoffmeister et al. (1967) for ooid- and pellet-moldic porosity characteristic of the Miami Limestone.

The oomoldic-recrystallized facies represents a common, slightly altered form of type ooid calcarenite wherein the original ooid and pellet grains were dissolved leaving only spherical and ellipsoidal voids in cement. In some of the oomolds characteristic of this facies, a white film (the outermost lamination of the original ooid) remains as a lining on the inner surface of the oomold. Very fine to fine quartz sand grains (relict ooid nuclei) also remain within some of the oomolds locally in Broward and southeastern Palm Beach Counties. The facies varies from burrowed to cross-bedded to massive and unbedded.

Oomoldic-recrystallized lithofacies occurs in portions of Broward, southeastern Palm Beach, southeastern Collier, and western and northern Dade Counties (Figure 5). This facies also occurs very thinly-interlayered with ooid calcarenite to form cross-beds in the type area (compare Figures 1 and 5).

Figure 6 shows the section diagram obtained from the south wall of the Hillsboro Canal approximately 2.75 miles west of the U.S. Highway 441 bridge in extreme southern Palm Beach County (Township 47 South, Range 41 East, Section 26, southwest quarter). Bed 1 consists of slightly oolitic, somewhat shelly, calcilutite-cemented quartz sand. Bed 2 is composed of somewhat shelly and sandy (quartz) oomoldic-recrystallized facies. Bed 3 consists of massive, abundantly sandy (quartz) micrite with very scattered Archaias sp. (a large foraminifer); and bed 4 consists of oolitic molluskan (Chione cancellata) calcirudite. Both beds 3 and 4 are discontinuous in the area.

Calcirudite

The calcirudite lithofacies of the Miami Limestone consists of abundant to common, small

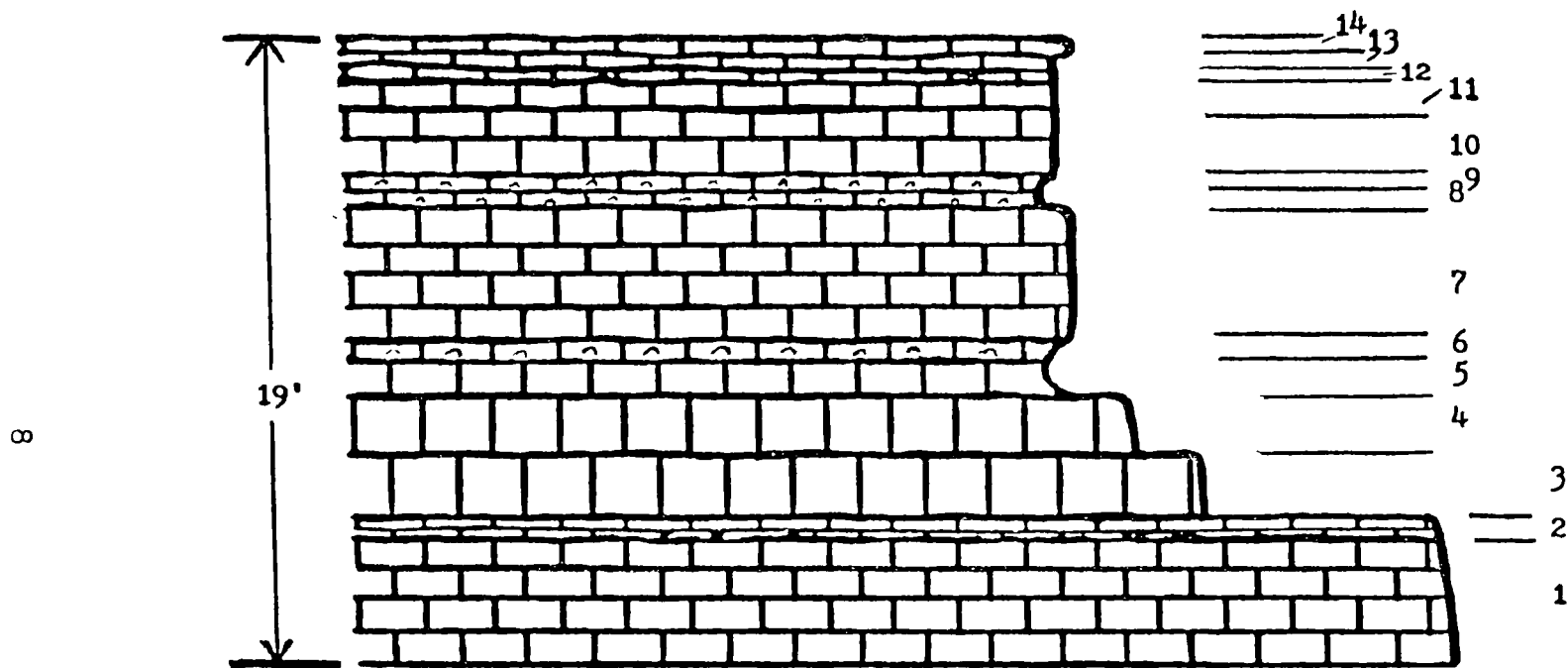


Figure 4. Section diagram of thickest exposure of Miami Limestone, Coral Gables Canal, LeJeune Road and Sunset Drive, Coral Gables, Dade County.

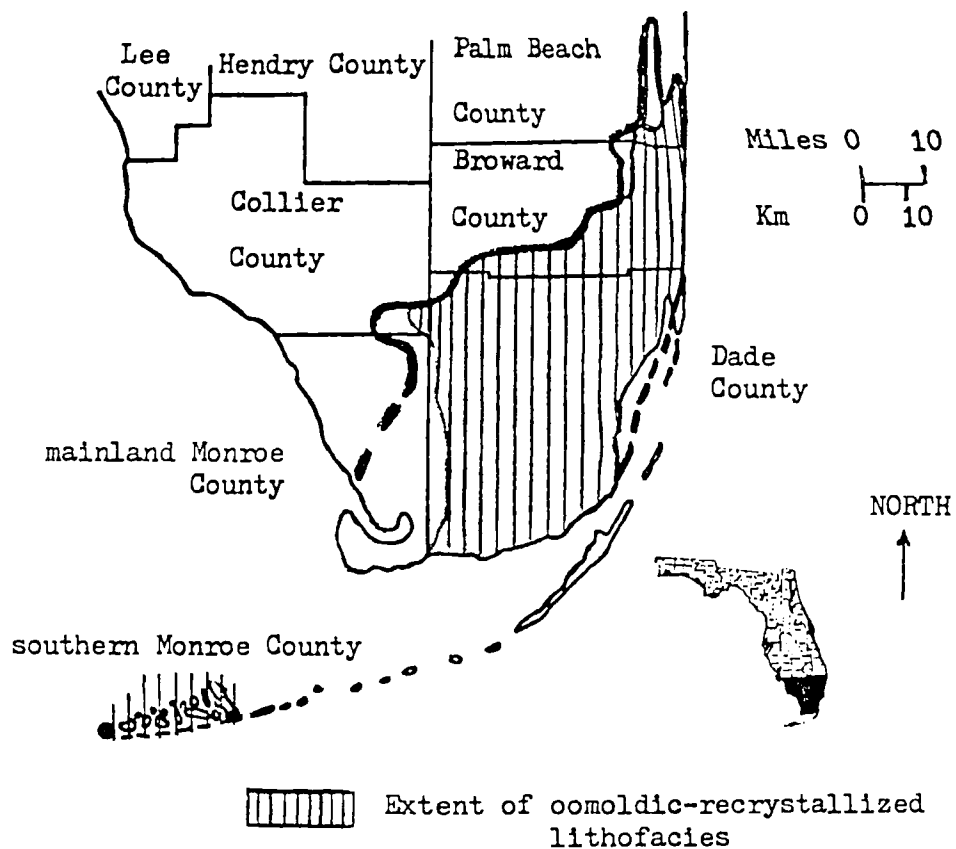


Figure 5. Map showing approximate extent of oomoldic-recrystallized lithofacies of the Miami Limestone.

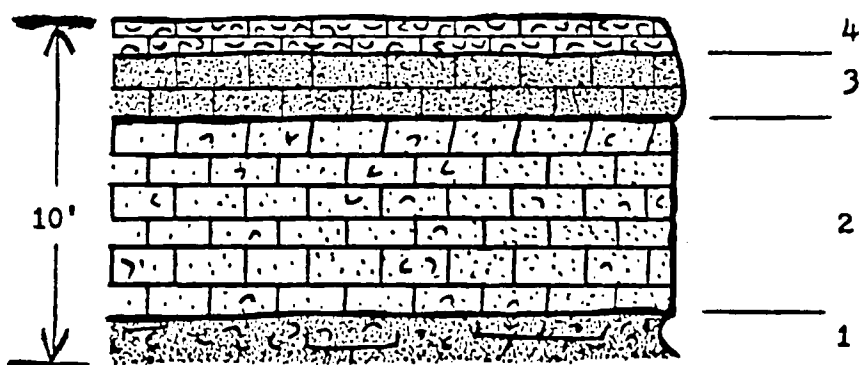


Figure 6. Section diagram of Hillsboro Canal in Palm Beach County.

mollusks, or tubular bryozoan colonies, or large foraminifera, with intermixed or very thinly-interbedded layers of ooids and pellets. All grains are generally unaltered and unrecrystallized and are moderately well- to very well-cemented by micrite to microspar to cryptocrystalline calcite. The facies contains only a low proportion (5% or less) of quartz sand and ranges from massive to burrowed to cross-bedded. Three subfacies of the calcirudite lithofacies occur in the Miami Limestone: molluskan, bryozoan, and foraminiferal.

In eastern Dade County (in the Atlantic Coastal Ridge), eastern Broward County, and the extreme eastern portion of southeastern Palm Beach County, the dominant mollusk present in the molluskan calcirudite subfacies of the Miami Limestone is Donax sp., the "coquina-shell". The cement in this lithology consists of either microspar or cryptocrystalline calcite.

Figure 7 shows the section diagram obtained from the south wall of the Dania Cutoff Canal at the railroad bridge just west of the U.S. Highway 1 bridge in Dania, eastern Broward County (Township 50 South, Range 42 East, Section 34, northwest quarter). Beds 2 through 5 consist of various forms of oolitic, Donax sp. molluskan calcirudite. Beds 1 and 6 consist of ooid calcarenite, with bed 6 being massive and bed 1, burrowed.

The northernmost extent of this oolitic or pelletal, Donax sp. molluskan calcirudite occurs in the city of Boynton Beach (on the mainland in the extreme eastern portion of southeastern Palm Beach County, Figure 1). The lithology occurs as a thin (less than 10 feet) tongue of Miami between overlying and underlying sections of nonoolitic Donax sp.-rich (Anastasia Formation) coquina and shelly sandstone. The top of this very finely, but abundantly oolitic northeasternmost tongue of Miami occurs at a depth of 30 feet below land surface.

Oolitic Donax sp. molluskan calcirudite also occurs thinly- to thickly-interbedded with type ooid calcarenite in the central portion of the Atlantic Coastal Ridge of southeastern Dade County.

The other small pelecypod characteristic of the molluskan calcirudite subfacies of the Miami is Chione cancellata. The oolitic, C. cancellata molluskan calcirudite lithology occurs very discontinuously in western and central Dade (west of the Atlantic Coastal Ridge), southeastern Collier, and mainland Monroe Counties, and much more continuously in Broward County and southern Palm Beach County. It consists of massive, very hard and well-cemented, slightly to abundantly sandy (quartz), slightly to moderately oolitic micrite or partially recrystallized calcilutite which contains common to abundant, unaltered, whole and fragmented C. cancellata (Figure 6, bed 4).

Where the Miami Limestone consists of molluskan calcirudite, other pelecypod and gastropod species may also be present, but are generally not as abundant and characteristic as Donax sp. and C. cancellata. In some areas, it is also common to find both of these species intermixed in exposures of the Miami Limestone.

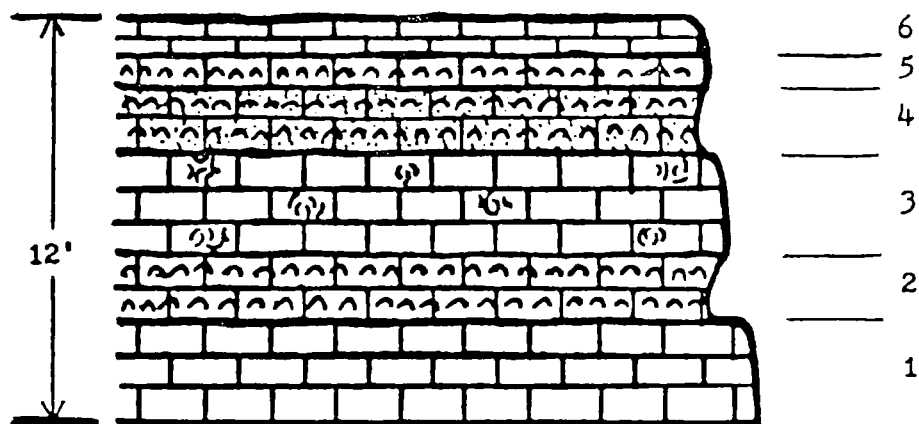


Figure 7. Section diagram of Dania Cutoff Canal in Broward County.

The bryozoan calcirudite subfacies of the Miami Limestone consists of common to abundant, tubular, Cheilostome bryozoan colonies and scattered to abundant pellets and ooids very poorly-cemented by unrecrystallized calcilutite, or very well-cemented by very finely recrystallized micrite or microspar. The bryozoan colonies may be unaltered and unrecrystallized or completely recrystallized. This subfacies is generally thickly-bedded and highly burrowed. Bryozoan calcirudite occurs primarily in the subsurface west of the Atlantic Coastal Ridge in Dade County and extreme southern Broward County (Hoffmeister et al., 1967; Halley and Evans, 1983).

A moderately rare, foraminiferal calcirudite subfacies of the Miami Limestone crops out discontinuously in southeastern Collier County and occurs locally in the subsurface of Broward and northern and western Dade Counties, generally at or near the base of the formation. It consists of abundant to common Archaias sp., a large planispiral foraminifer, and intermixed ooids or pellets very well- to poorly-cemented by microspar, micrite or calcilutite. The foraminiferal calcirudite subfacies of the Miami may be either burrowed or massive.

Figure 8 shows the section diagram obtained from an exposure along the south bank of the Tamiami Canal approximately 1.25 miles west of 50-Mile-Bend (Township 53 South, Range 33 East, Section 13, northwest quarter of southwest quarter). Bed 2, the basal bed of the Miami Limestone (at this location immediately overlying the very finely-recrystallized limestone of the Tamiami Formation, bed 1), consists of oolitic, slightly brecciated, Archaias sp. foraminiferal calcirudite. Bed 3 consists of oolitic, C. cancellata molluskan calcirudite.

Oolitic calcirudite lithofacies occurs in the Miami Limestone both to the north and west of the primary ooid shoal (the present Atlantic Coastal Ridge of southeastern Dade County). Figure 9 shows the approximate geographic extent of the various subfacies of oolitic calcirudite. To the north, type ooid calcarenite interfingers with Donax sp. molluskan calcirudite in the Atlantic Coastal Ridge of Broward, extreme northern Dade, and extreme southeastern Palm Beach Counties. West of the ridge in Dade County, type ooid calcarenite interfingers with bryozoan calcirudite (Halley and Evans, 1983) which, in turn, grades into C. cancellata molluskan or foraminiferal calcirudite near the westernmost extent of the Miami (extreme western Dade, southeastern Collier, and mainland Monroe Counties).

Breccia

The oolitic breccia lithofacies of the Miami Limestone consists of pebble- to boulder-size, angular to subangular fragments of oolitic or pelletal limestone moderately well- to very well-cemented by micrite, microspar or partially recrystallized calcilutite. The facies also occurs as ooid- or pellet-rich cement lithifying nonoolitic and nonpelletal, angular to subangular limestone fragments. Scattered to common mollusks of diverse species and low to moderate percentages of quartz sand may also be present. Miami Limestone breccia facies can be differentiated into subfacies according to its stratigraphic location as intraformational or basal.

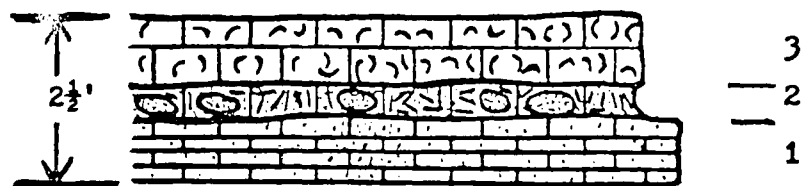


Figure 8. Section diagram of Tamiami Canal in southeastern Collier County.

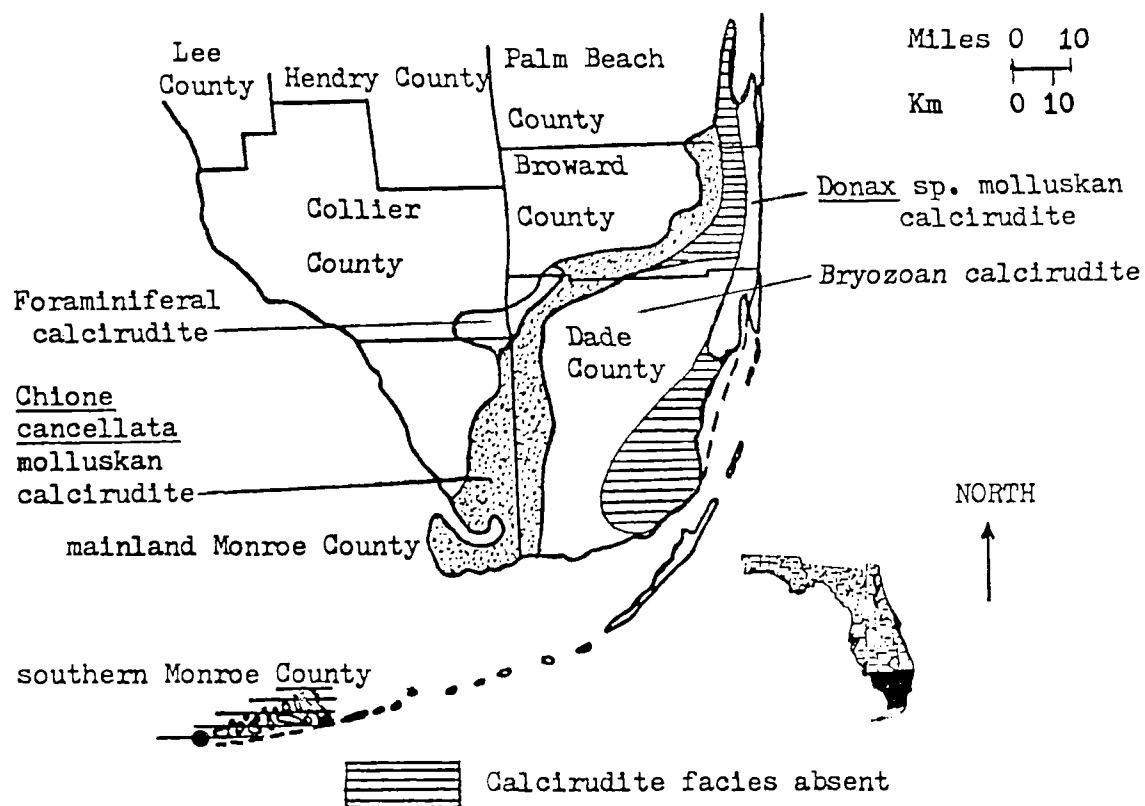


Figure 9. Map showing approximate extent of calcirudite lithofacies of the Miami Limestone.

the intraformational breccia subfacies is relatively rare in the Miami Limestone and occurs only very locally in outcrops along the Atlantic Coastal Ridge in Miami (Halley and Evans, 1983). The cement characteristic of this lithology is calcilutite, and the subfacies is typically poorly- to moderately well-consolidated. This lithology was not detected in cores or cuttings, probably because it is rare and partially because it would be difficult to recognize a very coarse-grained breccia in the relatively small samples obtained in both cores and cuttings.

Figure 10 shows the section diagram derived from an exposure near the intersection of Thirteenth Street and First Avenue in Miami (Township 54 South, Range 41 East, Section 38, southeast portion). Bed 1 consists of Donax sp. molluscan calcirudite and beds 2-3 (massive) and 5-9 (cross-bedded) consist of type ooid calcarenite. Bed 4 is composed of the shelly, oolitic intraformational breccia.

The most common form of basal-Miami breccia subfacies consists of angular to subangular fragments of ooid calcarenite or oomoldic-recrystallized lithofacies well- to very well-consolidated by nonoolitic, sandy (quartz), unfossiliferous, partially recrystallized calcilutite or micrite cement. This breccia occurs discontinuously in the subsurface of Broward County (west of the Florida Turnpike) and in north-central and western Dade County. The lithology is exposed in shallow ditches west of the Florida Turnpike in southeastern Palm Beach County, and is also discontinuous in that area.

Figure 11 shows a section diagram obtained from a shallow-ditch exposure on the east side of U.S. Highway 441 directly west of Boca Raton, Palm Beach County (Township 47 South, Range 42 East, Section 30, northwest quarter of southwest quarter). The highly-burrowed basal bed (1) consists of pebble- to cobble-size fragments of oolitic to oomoldic, somewhat sandy (quartz) limestone which are well-consolidated by finely-recrystallized calcite (which contains common to abundant quartz sand). The uppermost bed (2) consists of angular fragments of the same oolitic to oomoldic lithology, but very well-consolidated by unburrowed and massive, abundantly quartz-sandy calcilutite.

Quartz Sand or Sandstone

This somewhat geographically- and stratigraphically-restricted lithofacies of the Miami Limestone consists of slightly- to abundantly-oolitic, very well- to very poorly-cemented, very fine to medium quartz sand with rare coarse quartz sand grains. Unaltered C. cancellata, Donax sp. and other mollusks also occur in this facies. The cement varies from soft calcilutite to partially recrystallized calcilutite to hard microspar. Generally, quartz sand contained within the Miami Limestone is devoid of dark-colored heavy-mineral grains; however, very fine to fine heavy minerals locally do occur in the quartz sand or sandstone lithofacies in southeastern Palm Beach County in very small concentrations (less than 1%).

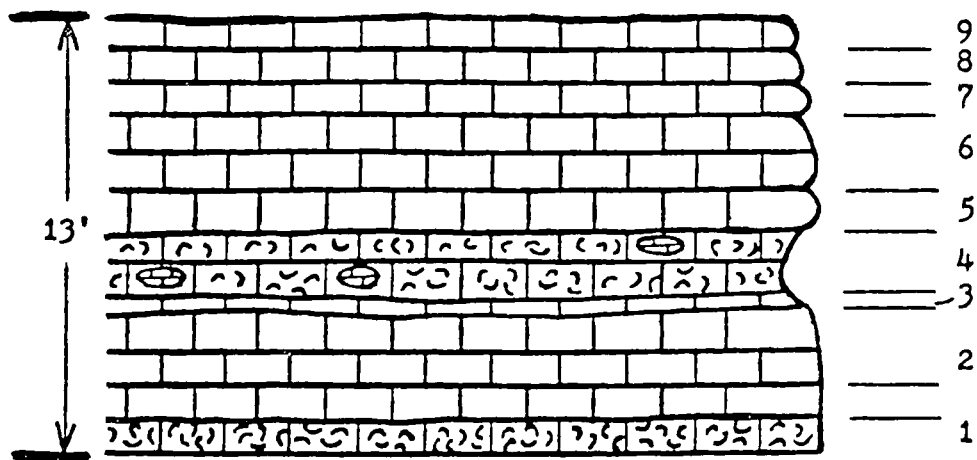


Figure 10. Section diagram of exposure at park at intersection of 13th Street and 1st Avenue, Miami, Dade County.

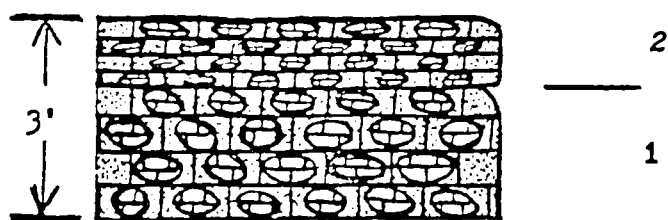


Figure 11. Section diagram of ditch west of Boca Raton, Palm Beach County.

The well-cemented sandstone subfacies is either burrowed or massive in sedimentary structure. The burrows are infilled by unconsolidated, locally shelly, oolitic quartz sand. The poorly-cemented subfacies generally lacks preserved burrows and is massive and unbedded to only slightly bedded.

The quartz sand or sandstone lithofacies occurs (Figure 12) continuously in extreme northern Broward County and discontinuously throughout most of the remainder of the Miami Limestone occurrence in Broward County. The facies also occurs extremely discontinuously in extreme northern Dade County west of the Atlantic Coastal Ridge. In all of these areas, the facies occurs only at the base of the Miami unit (Figure 6, bed 1).

The oolitic quartz sand or sandstone facies also occurs continuously in southeastern Palm Beach County (Figure 12). From west-northwest of Boca Raton northward along the Florida Turnpike as far as directly west of West Palm Beach (Haverhill area) the entire thickness of this northwesternmost tongue of the Miami consists of slightly- to abundantly-oolitic and fossiliferous (mollusks) quartz sand or sandstone. The base of the Miami unit in this area consists of unconsolidated to poorly-consolidated, sparsely fossiliferous, variably organic, only very slightly oolitic quartz sand.

Figure 13 shows the section diagram obtained from the south bank of the West Palm Beach Canal beneath the Haverhill Road bridge directly west of West Palm Beach, east-central Palm Beach County (Township 44 South, Range 42 East, Section 1, northwest quarter of northwest quarter). Bed 1 of the section represents the only very slightly oolitic and shelly basal bed of the Miami in the area. The remainder of the very thin Miami unit consists of moderately- to abundantly-shelly (predominantly Donax sp. and C. cancellata) quartz sandstone (bed 2) and sand (bed 3).

Because this oolitic quartz sand or sandstone lithofacies macroscopically resembles Fort Thompson Formation, some geologists prefer to include it in that formation (T.M. Scott, FGS, personal communication, 1991). In addition, some geologists "would call this [lithology] Anastasia [Formation] transitional to Miami Limestone" (T.M. Scott, FGS, personal communication, 1992). However, because the one unique and defining characteristic of the Miami Limestone is the presence of ooids or pellets, the present report includes this oolitic quartz sand and sandstone lithofacies within the Miami Limestone.

Microsparry-coraline Limestone

This extremely minor lithofacies of the Miami Limestone is composed of hard, nonsandy, oolitic, microsparry (finely recrystallized) limestone with some oomoldic-recrystallized zones. The microspar ranges from silt size to very fine sand size. Scattered to common coral molds are characteristic and the facies also locally contains scattered Archaias sp. as well as very scattered, very small, dwarfed or immature mollusks. The corals are identical to those charac-

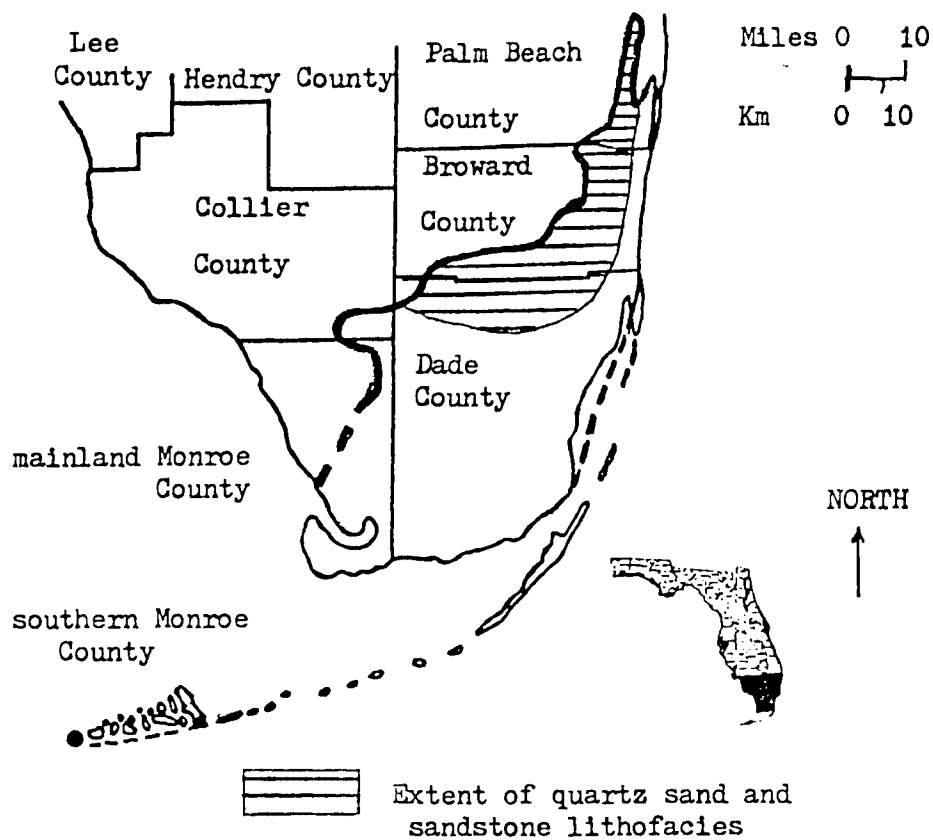


Figure 12. Map showing approximate extent of quartz sand and sandstone lithofacies of the Miami Limestone.



Figure 13. Section diagram of West Palm Beach Canal, Palm Beach County.

teristic of the Key Largo Limestone.

The occurrence of microsparry-coralline facies is extremely stratigraphically- and geographically-constrained to the Lower Keys, southern Monroe County, and a very small portion of extreme southeastern Dade County (Figure 14). This facies represents only an extremely minute fraction of the total volume of the Miami Limestone.

Figure 15 shows a composite section diagram derived from three very thin exposures on southern Big Pine Key, Lower Keys, southern Monroe County (Township 66 South, Range 29 East, Section 36 and Township 67 South, Range 29 East, Section 1). Bed 1 represents the massive, coralline Key Largo Limestone and bed 2 represents the basal-Miami, microsparry-coralline facies. Bed 3 is composed of partially- and very finely-recrystallized, tan ooid calcarenite.

SUMMARY

The upper Pleistocene Miami Limestone of south peninsular Florida consists of type ooid calcarenite and five additional lithofacies, all of which contain ooids and/or pellets in some recognizable form. These lithologies are: oomoldic-recrystallized limestone; molluscan, bryozoan or foraminiferal calcirudite; intraformational or basal breccia; quartz sand or sandstone; and microsparry-coralline limestone.

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APPENDIX

PART 1: Exposures of Miami Limestone Collected and Described for this Report

Name and General Description	T-R-S Location	Formations Exposed*	Total Thickness of Section
Broward			
Sawgrass Expressway at Lyons Blvd, active/dewatered pit	T48S/R42E/S5	Mi/Ft. T	21'
Dania Cutoff Canal cut at railroad bridge, south wall	T50S/R42E/S34	Miami	14'
Middle River Canal at University, canal cut, S bank	T49S/R41E/S28	Miami	4'

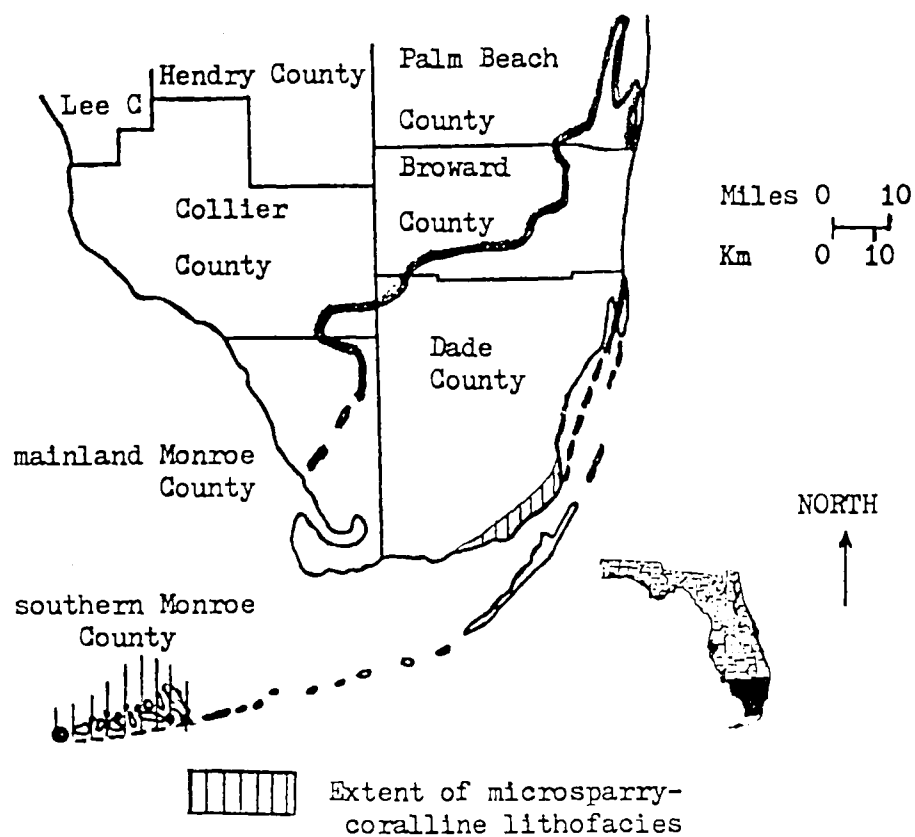


Figure 14. Map showing approximate extent of microsparry-coralline facies of the Miami Limestone.

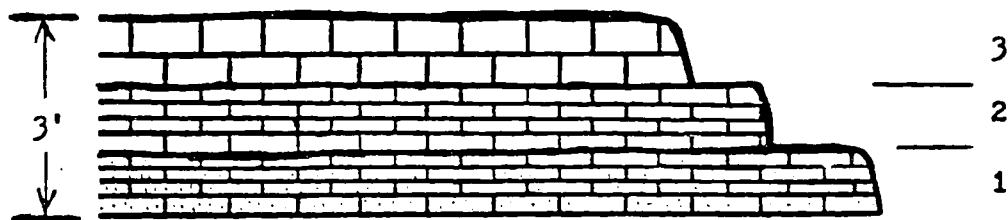


Figure 15. Composite section diagram of exposures on Big Pine Key, southern Monroe County.

PART 1: Exposures of Miami Limestone Collected and Described for this Report (continued)

Name and General Description	T-R-S Location	Formations Exposed*	Total Thickness of Section
Deep ditch cut, south of Sample Road, W of US 441	T48S/R41E/S13	Miami	2'
Ditch cut to N of SR 84, 2.3 miles east of US 27	T49S/R39E/S36	Miami	2'
South bank of South New River Canal .45 mi W of US 27	T50S/R39E/S27	Miami	2'
Snake Creek Canal at US 27, NE bank	T51S/R39E/S34	Miami	2'
Sample Road and Sawgrass Expressway, bank of canal to E	T48S/R41E/S19	Miami	1'
1 mi S of US 27 and CR 820, E bank of canal, W of US 27	T51S/R39E/S22	Miami	1'
Collier			
Tamiami Canal on east side of Monroe Station, S bank	T53S/R32E/S14	Mi/Tami	4'
Tamiami Canal, south bank, east of Monroe Station	T53S/R33E/S13	Mi/Tami	2½'
Tamiami Canal at abandoned buildings, S bank	T53S/R34E/S26	Miami	1'
Dade-Collier line, S bank, Tamiami Canal	T53S/R34E/S36	Mi/Tami	1'
1 mile E of 50-Mile Bend, S bank of Tamiami Canal	T53S/R34E/S26	Mi/Tami	1'
E of Gator Hook Strand, Tamiami Canal, S bank	T53S/R33E/S17	Miami	½'
Tamiami Canal @ Dade-Collier Transition & Training Jetpt	T53S/R34E/S16	Miami	½'
Dade			
LeJeune Road at Sunset Drive/Coral Gables Canal, S wall	T54S/R41E/S29	Miami	19'
SW 13th St and SW 1st Ave, Miami, park in NW quadrant	T54S/R41E/S38	Miami	13'
S Alice B. Wainwright Park, Miami, Silver Bluff scarp	T54S/R41E/S40	Miami	11'
Kendall Wayside Park, E of US 1, NE side of sinkhole	T55S/R40E/S10	Miami	10'
Perrine Wayside Park, E of US 1, SE side of sinkhole	T55S/R40E/S28	Miami	10'
North A.B. Wainwright Park, Silver Bluff scarp	T54S/R41E/S40	Miami	9'
SW 10th St at 100th block, Miami, S side/roadcut	T54S/R41E/S38	Miami	9'
SW 22nd Ave W of Bayshore Dr, Miami, Silver Bluff/rdcut	T54S/R41E/S15	Miami	8'
SW 7th St and SW 3rd Ave, Miami, SW quadrant, roadcut	T54S/R41E/S38	Miami	8'
Abandoned gasoline tank hole, W side of US 1, N Goulds	T56S/R40E/S7	Miami	6'
C-102 canal, N bank, 300 ft E of US 1, Princeton	T56S/R39E/S23	Miami	6'
SW 72nd Ave and SW 124th St, NW quadrant, rdcut, Kendall	T55S/R40E/S14	Miami	4'
Snapper Creek Canal cut at Old Cutler Road, NE bank	T55S/R41E/S7	Miami	4'
Old Rockpit #57, abandoned quarry, Goulds, E of US 1	T56S/R39E/S13	Miami	4'
1810 Brickell, W side of street, roadcut, downtown Miami	T54S/R41E/S39	Miami	2'
Tamiami Canal, 2 miles east of 40-Mile-Bend, S bank cut	T54S/R35E/S14	Miami	1'
C-31W canal E of Everglades National Pk entrance/W bank	T58S/R38E/S7	Miami	1'
S bank of canal N of Loop Road at Tamiami Trail	T54S/R35E/S21	Miami	1'
Monroe			
Blue Hole, abandoned quarry, N Big Pine Key, Lower Keys	T66S/R29E/S9	Miami	5'
Central Big Pine Key, canal cut, S end, Lower Keys	T66S/R29E/S23	Miami	4½'
Ditch cut to N of Loop Road, eastern Pinecrest, mainland	T54S/R34E/S20	Mi/Tami	2'
North Sugarloaf Key, canal cut, E bank, Lower Keys	T66S/R27E/S25	Miami	2'
Loop Road #5 toward W, N bank of canal S of rd, mainland	T54S/R34E/S22	Miami	1½'
Boca Chica key, ditch cut S of US 1, Lower Keys	T67S/R26E/S30	Miami	1½'
North Big Torch Key, canal cut, N bank, Lower Keys	T66S/R28E/S13	Miami	1'
South Big Pine Key, NE of US 1/shallow ditch, Lower Keys	T67S/R30E/S7	Miami	1'
Southmost Big Pine Key/W of CR 940, roadcut, Lower Keys	T67S/R29E/S1	Miami	1'
Loop Road #2 toward W, N bank of canal S of rd, mainland	T54S/R34E/S24	Miami	1'
Loop Road #3 toward W, N bank of canal S of rd, mainland	T54S/R34E/S22	Miami	½'
Loop Road #4 toward W, N bank of canal S of rd, mainland	T54S/R34E/S22	Miami	½'

PART 1: Exposures of Miami Limestone Collected and Described for this Report (continued)

Name and General Description	T-R-S Location	Formations Exposed*	Total Thickness of Section
Palm Beach			
Lox Road Pit, active/dewatered, S of Hillsboro Canal	T47S/R41E/S28	Mi/Ft. T	16'
Boynton Blvd at Turnpike, active/dewatered pit	T45S/R42E/S20	Miami	12'
Hillsboro Canal, thickest canal cut just W of bridge	T47S/R42E/S26	Miami	10'
Ditch cut east of US 441, west of Boca Raton	T47S/R42E/S30	Miami	6'
North Boca Rio Road, W bank of canal to east, Boca Raton	T47S/R42E/S20	Miami	5'
Hillsboro Canal at S side-canal	T47S/R42E/S29	Miami	4'
Penewestmost Hillsboro Canal, S bank	T47S/R42E/S28	Miami	4'
Powerline Rd @ Lk Worth Drainage District Canal/SW quad	T47S/R42E/S21	Miami	4'
West Palm Beach Canal beneath Haverhill Rd bridge/S bank	T44S/R42E/S1	Miami	4'
US 441/N bank of canal directly E of Lakes at Boca Raton	T47S/R42E/S7	Miami	3'
Turnpike, E bank of canal to W, near Boca Raton	T47S/R42E/S8	Miami	3'
Powerline Rd at Palmetto Park Rd/ditch cut in SE corner	T47S/R42E/S27	Miami	2'
Bank of canal N of Glades Road along US 441, Boca Raton	T47S/R42E/S18	Miami	2'
Bank of canal E of US 441 @ Central Park Blvd/Boca Raton	T47S/R42E/S19	Miami	2'
South Boca Rio Road, W bank of canal to east, Boca Raton	T47S/R42E/S29	Miami	1'
West section along Hillsboro Canal/E of Loxahatchee WMA	T47S/R41E/S20	Miami	1'
Deep ditch ½ Mi N of W Palm Beach Canal @ Haverhill Road	T43S/R42E/S35	Miami	1'
Deep ditch 1½ Mi N of W Palm Beach Canal @ Haverhill Rd	T43S/R42E/S26	Miami	1'

NOTE: *Mi or Miami= Miami Limestone; Ft. T= Fort Thompson Formation; Tami= Tamiami Formation

PART 2: Well-Cuttings and Cores Described for this Report

FGS Well Number (W-)	Type of Samples	T-R-S Location	Formation Below Miami (#depth to top of)
Broward			
161	cuttings	T50S, R38E, S29	Ft. Thompson
940	cuttings	T50S, R41E, S12	Ft. Thompson
1730	cuttings	T50S, R42E, S34	Anastasia
2068	noncontinuous core	T51S, R39E, S34	Ft. Thompson (12.75)
2069.....	noncontinuous core.....	T51S, R39E, S22.....	Ft. Thompson (9.7)
2070	noncontinuous core	T49S, R40E, S33	Ft. Thompson (15.4)
2071	noncontinuous core	T49S, R40E, S27	Ft. Thompson (6.8)
2083	noncontinuous core	T51S, R39E, S19	Ft. Thompson (4.6)
2084	noncontinuous core	T51S, R39E, S10	Ft. Thompson (3.8)
2087.....	noncontinuous core.....	T50S, R39E, S22.....	Ft. Thompson (5.0)
2101	noncontinuous core	T51S, R39E, S27	Ft. Thompson (5.5)
2289	cuttings	T49S, R42E, S3	Ft. Thompson
2943	cuttings	T50S, R42E, S2	Ft. Thompson
2955	cuttings	T50S, R42E, S2	Ft. Thompson
2957.....	cuttings.....	T50S, R42E, S3.....	Anastasia?
3412	cuttings	T51S, R41E, S26	Ft. Thompson
3601	cuttings	T51S, R41E, S21	Ft. Thompson
3745	cuttings	T51S, R42E, S26	Anastasia
3863	cuttings	T50S, R42E, S3	Ft. Thompson
4099.....	noncontinuous core.....	T49S, R42E, S5.....	Ft. Thompson (50)

PART 2: Well-Cuttings and Cores Described for this Report (continued)

FGS Well Number (W-)	Type of Samples	T-R-S Location	Formation Below Miami (#depth to top of)
4100	noncontinuous core	T49S, R42E, S5	Ft. Thompson (45)
4471	cuttings	T49S, R42E, S35	Ft. Thompson
5496	cuttings	T49S, R41E, S24	Ft. Thompson
5497	cuttings	T49S, R41E, S24	Ft. Thompson
5664.....	cuttings.....	T48S, R41E, S36.....	Ft. Thompson
5688	cuttings	T50S, R42E, S10	Ft. Thompson
5850	cuttings	T51S, R42E, S26	Ft. Thompson
5896	cuttings	T48S, R42E, S1	Anastasia
5897	cuttings	T48S, R42E, S25	Anastasia
6020.....	cuttings.....	T51S, R41E, S11.....	Ft. Thompson
6829	cuttings	T49S, R42E, S13	Ft. Thompson
6857	cuttings	T51S, R42E, S28	Ft. Thompson
7369	cuttings	T48S, R42E, S1	Anastasia
7553	cuttings	T49S, R42E, S7	Ft. Thompson
7560.....	cuttings.....	T49S, R42E, S14.....	Ft. Thompson
7561	cuttings	T49S, R42E, S14	Ft. Thompson
7563	cuttings	T49S, R42E, S14	Ft. Thompson
7639	cuttings	T50S, R42E, S10	Ft. Thompson
7693	cuttings	T48S, R43E, S13	Ft. Thompson
7839.....	cuttings.....	T48S, R42E, S12.....	Ft. Thompson?
7948	cuttings	T50S, R42E, S3	Ft. Thompson
8023	cuttings	T48S, R42E, S35	Anastasia?
8200	cuttings	T49S, R42E, S22	Ft. Thompson?
8613	noncontinuous core	T50S, R38E, S30	Ft. Thompson (10)
8614.....	noncontinuous core.....	T50S, R38E, S30.....	Ft. Thompson (5)
10536	cuttings	T49S, R41E, S9	Ft. Thompson
10803	cuttings	T50S, R42E, S31	Ft. Thompson?
11687	cuttings	T47S, R42E, S33	Ft. Thompson?
12322	cuttings	T50S, R41E, S32	Ft. Thompson
14068.....	cuttings.....	T50S, R42E, S2.....	Ft. Thompson
14109	cuttings	T52S, R42E, S34 §	Ft. Thompson
14110	cuttings	T52S, R42E, S34 §	Ft. Thompson
14111	cuttings	T52S, R42E, S34 §	Anastasia?
14474	cuttings	T50S, R40E, S25	Ft. Thompson
14721.....	cuttings.....	T50S, R42E, S18.....	Ft. Thompson
14744	cuttings	T50S, R41E, S36	Ft. Thompson
14870	cuttings	T47S, R41E, S35	Ft. Thompson
16050	cuttings	T49S, R41E, S34	Ft. Thompson
16459	cuttings	T51S, R42E, S17	Ft. Thompson
16526.....	noncontinuous core.....	T50S, R40E, S4.....	Ft. Thompson (8)
Collier			
10187	cuttings	T52S, R33E, S22	Ft. Thompson
Dade			
42	cuttings	T53S, R41E, S19	Ft. Thompson
160	cuttings	T54S, R37E, S7	Ft. Thompson
468	cuttings	T52S, R40E, S30	Ft. Thompson
481.....	cuttings.....	T52S, R41E, S9.....	Ft. Thompson

PART 2: Well-Cuttings and Cores Described for this Report (continued)

FGS Well Number (W-)	Type of Samples	T-R-S Location	Formation Below Miami (#depth to top of)
637	cuttings	T57S, R39E, S14	Ft. Thompson
815	noncontinuous core	T54S, R41E, S2	Ft. Thompson (42)
931	cuttings	T54S, R35E, S21	Ft. Thompson
2064	noncontinuous core	T53S, R38E, S36	Ft. Thompson (1.4)
2065.....	noncontinuous core.....	T53S, R38E, S36.....	Ft. Thompson (2.7)
2066	noncontinuous core	T52S, R39E, S10	Ft. Thompson (2.4)
2096	noncontinuous core	T53S, R38E, S24	Ft. Thompson (5.8)
2618	cuttings	T52S, R42E, S34	Ft. Thompson?
3484	cuttings	T57S, R39E, S1	Ft. Thompson
3488.....	cuttings.....	T57S, R39E, S1.....	Ft. Thompson
3491	cuttings	T54S, R36E, S19	Ft. Thompson
3517	cuttings	T57S, R39E, S1	Ft. Thompson
4325	cuttings	T52S, R42E, S21	Ft. Thompson
5215	cuttings	T55S, R42E, S5	Ft. Thompson?
5216.....	cuttings.....	T54S, R41E, S16.....	Ft. Thompson
5222	cuttings	T53S, R41E, S25	Ft. Thompson
5345	cuttings	T54S, R41E, S5	Ft. Thompson
5428	cuttings	T53S, R40E, S12	Ft. Thompson
5449	cuttings	T52S, R42E, S32	Ft. Thompson
5508.....	cuttings.....	T54S, R40E, S28.....	Ft. Thompson
5511	cuttings	T54S, R41E, S11	*TD 38'
5542	cuttings	T55S, R40E, S7	Ft. Thompson
5543	cuttings	T54S, R41E, S20	Tamiami?
5544	cuttings	T52S, R42E, S11	Ft. Thompson
5578.....	cuttings.....	T52S, R42E, S17.....	Ft. Thompson
5579	cuttings	T55S, R40E, S31	Ft. Thompson
5732	cuttings	T52S, R41E, S2	Ft. Thompson
5739	cuttings	T55S, R40E, S28	Ft. Thompson
5765	cuttings	T54S, R41E, S1	Ft. Thompson
5849.....	cuttings.....	T52S, R42E, S17.....	Ft. Thompson
6195	cuttings	T53S, R40E, S21	Ft. Thompson
6196	cuttings	T52S, R41E, S36	Ft. Thompson?
6208	cuttings	T56S, R40E, S7	Ft. Thompson
6209	cuttings	T55S, R40E, S23	Ft. Thompson
6387.....	cuttings.....	T58S, R38E, S7.....	Ft. Thompson
6843	cuttings	T56S, R40E, S6	Ft. Thompson
6860	cuttings	T55S, R40E, S10	Ft. Thompson
7363	cuttings	T58S, R37E, S14	Ft. Thompson
7555	cuttings	T55S, R42E, S5	Ft. Thompson
7884.....	cuttings.....	T55S, R40E, S32.....	*TD= 20'
7885	cuttings	T55S, R40E, S32	*TD= 20'
8057	cuttings	T54S, R41E, S20	Ft. Thompson
8486	cuttings	T54S, R41E, S1	Ft. Thompson (23.5)
9191	cuttings	T55S, R36E, S6	Ft. Thompson
10303.....	cuttings.....	T55S, R40E, S21.....	Ft. Thompson
10315	cuttings	T53S, R41E, S11	Ft. Thompson
10602	cuttings	T57S, R39E, S5	Ft. Thompson
12163	cuttings	T52S, R42E, S7	Ft. Thompson
12170	cuttings	T52S, R41E, S12	Ft. Thompson

PART 2: Well-Cuttings and Cores Described for this Report (continued)

FGS Well Number (W-)	Type of Samples	T-R-S Location	Formation Below Miami (#depth to top of)
12295.....	cuttings.....	T58S, R39E, S26.....	Ft. Thompson
12296	cuttings	T58S, R39E, S26	Ft. Thompson
12997	cuttings	T53S, R41E, S18	Ft. Thompson
14497	cuttings	T51S, R42E, S34	Ft. Thompson
14824	cuttings	T56S, R40E, S21	Ft. Thompson?
15019.....	cuttings.....	T53S, R39E, S14.....	Ft. Thompson
15264	cuttings	T58S, R39E, S12	Ft. Thompson
16024	noncontinuous core	T57S, R38E, S26	Ft. Thompson (25)
16025	noncontinuous core	T57S, R38E, S26	Ft. Thompson (25)
16026	noncontinuous core	T57S, R38E, S26	Ft. Thompson (22.5)
16395.....	continuous core.....	T58S, R36 ¹ / ₂ E, S1.....	Ft. Thompson (16)
16435	noncontinuous core	T57S, R39E, S14	Ft. Thompson (20)
16436	noncontinuous core	T58S, R35E, S26	Ft. Thompson (14)
16437	noncontinuous core	T55S, R37E, S6	Ft. Thompson (10)
16439	noncontinuous core	T54S, R40E, S1	Ft. Thompson (5)
16440.....	noncontinuous core.....	T55S, R37E, S25.....	Ft. Thompson (16)
16442	noncontinuous core	T52S, R39E, S3	Ft. Thompson (3.5)
16443	noncontinuous core	T54S, R38E, S2	Ft. Thompson (10)
16444	noncontinuous core	T54S, R40E, S7	Ft. Thompson (12)
16445	noncontinuous core	T54S, R41E, S10	Ft. Thompson (17)
16446.....	noncontinuous core.....	T57S, R37E, S6.....	Ft. Thompson (12)
16447	noncontinuous core	T57S, R38E, S6	Ft. Thompson (15.5)
16448	noncontinuous core	T57S, R39E, S31	Ft. Thompson (22)
16449	noncontinuous core	T59S, R39E, S5	Ft. Thompson (26)
16450	noncontinuous core	T59S, R38E, S3	Ft. Thompson (22)
16451.....	noncontinuous core.....	T55S, R38E, S10.....	Ft. Thompson (5)
16453	noncontinuous core	T54S, R39E, S30	Ft. Thompson (15)
16455	noncontinuous core	T54S, R38E, S35	Ft. Thompson (10)
 Monroe			
137	noncontinuous core	T68S, R25E, S6 (Lower Keys)	Key Largo (34)
265	cuttings	T67S, R25E, S31 (Lower Keys)	Key Largo
972.....	cuttings.....	T67S, R29E, S2 (Lower Keys)...	Key Largo
2402	cuttings	T60S, R34E, S22 (mainland)	Ft. Thompson (20)
 Palm Beach			
771	cuttings	T47S, R43E, S19	Anastasia?
7365	cuttings	T46S, R43E, S32	Anastasia?
7366	cuttings	T47S, R43E, S19	Anastasia?
7368.....	cuttings.....	T47S, R43E, S19.....	Anastasia?
7852	cuttings	T46S, R43E, S20	Anastasia
7861	cuttings	T45S, R43E, S28	Anastasia
8303	cuttings	T43S, R42E, S23	Ft. Thompson
8683	cuttings	T47S, R43E, S17	Anastasia
8692.....	cuttings.....	T47S, R43E, S8.....	Anastasia?
8695	cuttings	T47S, R43E, S8	Anastasia?
8696	cuttings	T47S, R43E, S8	Ft. Thompson
9108	cuttings	T45S, R41E, S25	Ft. Thompson
9109	cuttings	T45S, R42E, S14	Ft. Thompson

PART 2: Well-Cuttings and Cores Described for this Report (continued)

FGS Well Number (W-)	Type of Samples	T-R-S Location	Formation Below Miami (#depth to top of)
10585.....	cuttings.....	T47S, R42E, S30.....	Ft. Thompson
11513	cuttings	T47S, R43E, S30	Ft. Thompson?
12222	cuttings	T45S, R43E, S33	Anastasia
12423	cuttings	T46S, R42E, S4	Ft. Thompson
12424	cuttings	T44S, R42E, S34	Ft. Thompson
12428.....	cuttings.....	T42S, R42E, S16.....	Ft. Thompson
12445	cuttings	T47S, R42E, S13	Ft. Thompson?
12448	cuttings	T40S, R42E, S26	Ft. Thompson
12673	cuttings	T43S, R42E, S33	Ft. Thompson
13227	cuttings	T46S, R43E, S21	Anastasia
13741.....	cuttings.....	T42S, R43E, S30.....	Ft. Thompson
14953	cuttings	T47S, R42E, S11	Ft. Thompson
15099	cuttings	T42S, R42E, S30	Ft. Thompson
15144	cuttings	T47S, R42E, S30	Ft. Thompson
16062	noncontinuous core	T46S, R41E, S25	Ft. Thompson (14)
16074.....	noncontinuous core.....	T47S, R42E, S20.....	Ft. Thompson (10)

NOTES

#Depth to top of underlying formation is given in parentheses only for continuous and noncontinuous or partial cores (and some excellent cuttings) in feet below land surface.

*TD= xy' indicates that the well attained total depth at the given (xy) feet below land surface without fully penetrating the Miami Limestone.

§ Given location in Dade County but Broward County location more likely.

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FLORIDA GEOLOGICAL SURVEY