

STATE OF FLORIDA
DEPARTMENT OF NATURAL RESOURCES
Randolph Hodges, *Executive Director*

DIVISION OF INTERIOR RESOURCES
Robert O. Vernon, *Director*

BUREAU OF GEOLOGY
Charles W. Hendry, Jr., *Chief*

BULLETIN NO. 54

PART I
SUWANNEE LIMESTONE IN HERNANDO AND
PASCO COUNTIES, FLORIDA

By
J. William Yon, Jr. and Charles W. Hendry, Jr.

PART II
PETROGRAPHY OF THE SUWANNEE LIMESTONE

By
Anthony F. Randazzo

Prepared by the
FLORIDA DEPARTMENT OF NATURAL RESOURCES
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TALLAHASSEE, FLORIDA
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**DEPARTMENT
OF
NATURAL RESOURCES**

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LETTER OF TRANSMITTAL



Bureau of Geology
Tallahassee
December 7, 1971

Honorable Reubin O'D. Askew, *Chairman*
Department of Natural Resources
Tallahassee, Florida

Dear Governor Askew:

The Department of Natural Resources, Bureau of Geology, is publishing Bulletin No. 54. Part I is entitled "Suwannee Limestone in Hernando and Pasco Counties, Florida" by J. W. Yon, Jr. and C.W. Hendry, Jr., Bureau geologists, and Part II is entitled "Petrography of the Suwannee Limestone" by A. F. Randazzo, Professor, Department of Geology, University of Florida.

The Suwannee Limestone, a major component of the geology of the area, is suitable for use in many manufacturing processes. In achieving the orderly development of our land resources it is necessary to have a knowledge of the occurrence, quantity and quality of the mineral resources.

The data presented herein will assist the land-use planners and the mineral industry in providing for full development of Hernando and Pasco counties.

Respectfully yours,

Charles W. Hendry, Chief
Bureau of Geology

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and

Charles W. Hendry, Jr.

Tallahassee, Florida
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Gratitude is expressed to Muriel Hunter and Joseph Banks (Coastal Petroleum Company) for giving freely of their information on the fossils of the area and for accompanying the writers to the field on several occasions.

The Brooksville Rock Company, the Camp Concrete and Rock Company, and the McDonald Corporation were most cooperative in allowing the writers access to their quarries.

The writers are grateful to Robert O. Vernon, Chief of the Bureau of Geology, for his helpful suggestions and efforts in making this study possible.

PREVIOUS INVESTIGATIONS

In many of the reports on the geology of Florida, reference is made to Hernando and Pasco counties. However, only those publications which present more than a cursory report of the geology of the area are mentioned below.

Mossom (1925, 1926), Cooke and Mossom (1929) and Cooke (1945) discussed the general geology of the area. Mansfield (1937), described the mollusks collected from quarries and outcrops in the area of study.

Carr and Alverson (1959), in their West-Central Florida study, discussed the middle Tertiary rocks in Pasco County. Ketner and McGreevy (1959) discussed the Cenozoic rocks occurring in the hard-rock phosphate belt along the eastern edge of Hernando County. Wetterhall (1964), briefly discussed the geology in Hernando and Pasco counties. Shannon (1967), in his study of the foraminiferal faunas of the Tampa and Suwannee limestones at or near the contact of the two formations, discussed two localities in Hernando County.

SUWANNEE LIMESTONE IN HERNANDO AND PASCO COUNTIES, FLORIDA

By
J. William Yon, Jr. and Charles W. Hendry, Jr.

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The competition between the mineral and agricultural industries for the use of land, as well as the overshadowing demands of urban sprawl for land, make it imperative that more aspects of the natural resources be available for efficient land use planning. One important aspect of the natural resources in any area is the geology. Limestone, a major component of the geology, occurs in abundance at or near the surface in Hernando and Pasco counties. Several principal uses of this rock are in road building, agriculture, as an aggregate and in the manufacture of cement. The purpose of this report was to provide information on the distribution and character of the Suwannee Limestone in Hernando and Pasco counties. The study was started in 1969 and has been conducted intermittently since that time. Data on the geology were collected through examination of the quarries in the two counties and surrounding area and through the study of rock cuttings from numerous wells in Hernando, Hillsborough, Pasco, Pinellas, and Sumter counties.

LOCATION OF AREA

The area of study encompasses Hernando and Pasco counties which are located along the western side of the central Peninsula, as shown in figure 1. The area is bounded on the north by Citrus County, on the east by Sumter and Polk counties, the Gulf of Mexico on the west, and Pinellas and Hillsborough counties on the south.

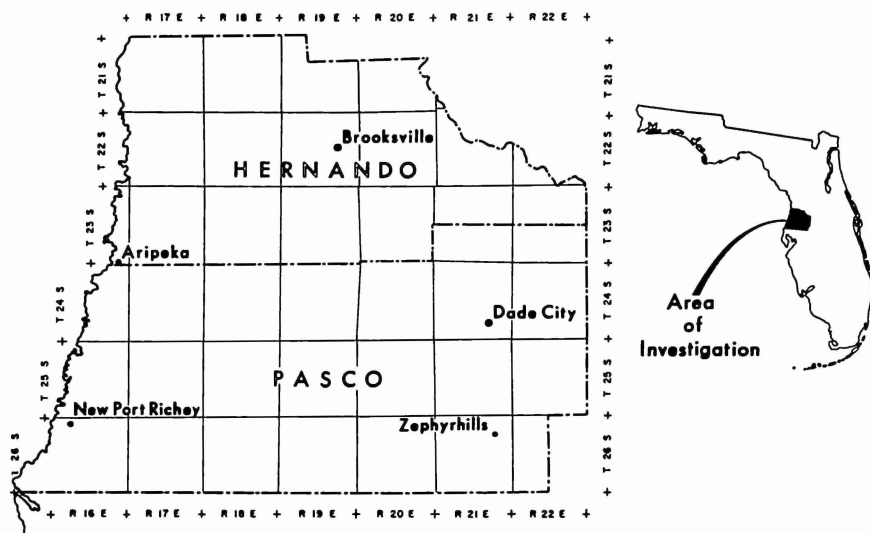


Figure 1. Location of Hernando and Pasco counties.

MAPS

All of Hernando and Pasco counties are covered by U.S. Geological Survey and U.S. Army Corps of Engineers topographic maps in the 7½ minutes series see (figure 2) and by Florida Department of Transportation general highway maps. The base map used in this report was made from a U.S. Geological Survey base map.

TRANSPORTATION

Hernando and Pasco counties are served by the Seaboard Coast Line Railroad.

The four major U.S. Highways that traverse Hernando County are Interstate 75, U.S. Highways 19, 41 and 98. Three of these, Interstate 75, U.S. Highways 19 and 41, traverse Pasco County.

Numerous state highways cover the area, generally radiating from the county seats. In addition there are abundant secondary paved roads and graded roads that permit access to almost every portion of the two counties.

WELL AND OUTCROP NUMBERING SYSTEM

The well and outcrop numbering system used in this report is based on

location of the well or outcrop and 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 outcrop, county abbreviation, the quarter/quarter location within the section, the section, township, and range.

The State of Florida is divided into large squares which measure six miles on each side. These large squares are consecutively numbered both north or south and east or west from a marker located in Tallahassee. The north or south measurements are called townships and the east or west measurements are called ranges. For example, a location designated Township 22 South (T22S), Range 20 East (R20E) is 22 large squares south and 20 large squares east of the Tallahassee marker. In locality and well numbers the T and R are left off, as 22S and 20E.

To further identify a location the large squares (six miles on each side) are divided into 36 equal squares called sections. The sections are further divided into quarters with the quarters labeled "a" through "d". In turn, each of these quarters may be divided into quarters with these quarter/quarter squares labeled "a" through "d" (see figure 3).

The breakdown of the locality designated LHR22S-19E-8ac would be:

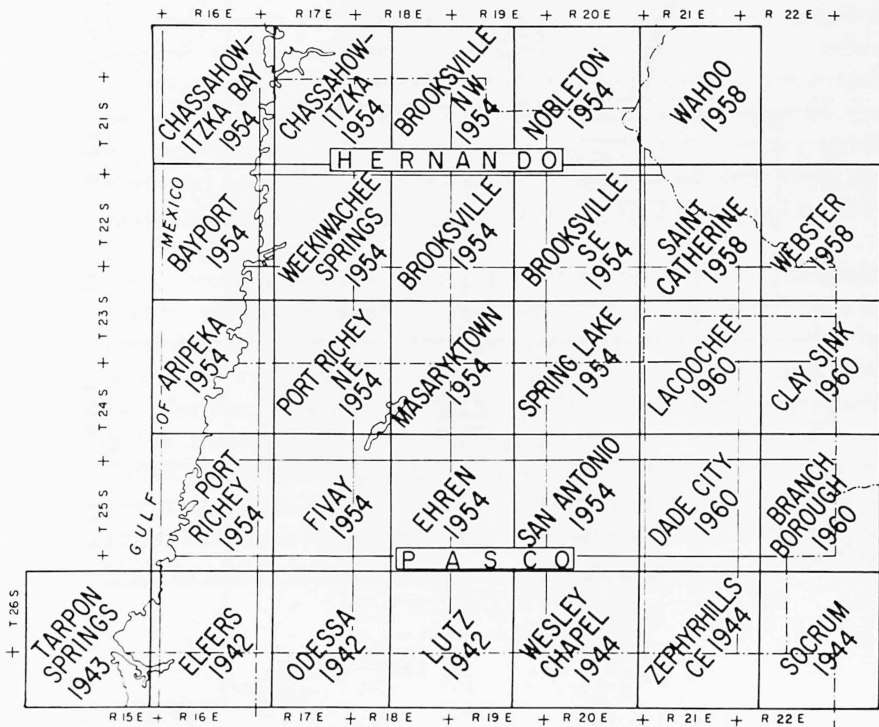


Figure 2. Index to Topographic Maps of Hernando and Pasco counties.

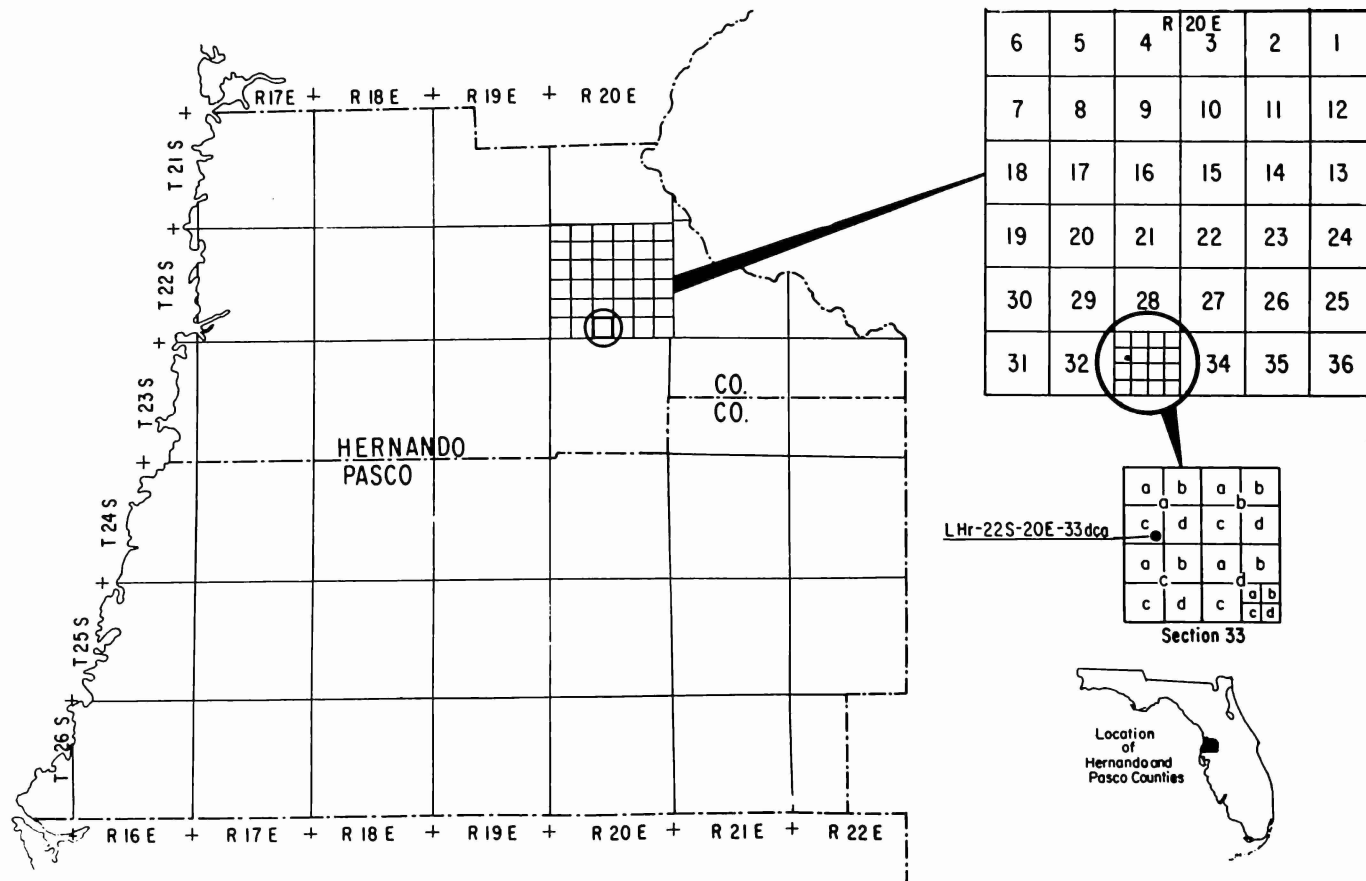


Figure 3. Well and outcrop numbering system.

L designates an outcrop as opposed to a well, Hr indicates Hernando County, 22S-19E means 22 large squares south and 19 large squares east of the Tallahassee marker, 8 designates section number, and ac then places the outcrop in the northwest quarter of the southwest quarter of the section (fig. 3).

The abbreviation used for counties in this report are Ci for Citrus, Hr for Hernando, and Ps for Pasco, Po for Polk, and Sm for Sumter. For example, the well numbered WHr-22S-20E-23 aa is located in the northwest quarter of the northwest quarter of section 22 in Township 22 South, Range 20 East.

ANALYTICAL PROCEDURES

Sixty-one water wells, one core hole, 12 quarries and three outcrops were selected for the study. Their locations are shown in figure 4 and geologic details of the wells are listed in Table 1.

Cuttings from the water wells, cores, outcrops and quarry samples were examined under a binocular microscope. Each sample was examined for lithology, color, crystallinity, other minerals present, cement, degree of cementation, porosity, and fossils present.

As this study was primarily a lithologic evaluation no detailed paleontological work was done. However, fossils described by other workers as diagnostic were identified during the binocular examination of all the above samples. Mention of these along with some of the described macrofossils will appear later in the text. Petrographic examination and comments by Randazzo of samples collected from the quarry operated by Camp Concrete and Rock Company of Brooksville is included as Part II.

Secondary recrystallization frequently obliterates basic lithologic characteristics which are used for correlation and age determination. Minor insoluble constituents deposited contemporaneously with the basic carbonate are sometimes useful for bed differentiation and correlation. For this reason minor lithologic differences were determined by using the insoluble residues. Fifty-gram portions were used from samples collected from four quarries in Hernando County. These samples were digested in dilute hydrochloric acid. The amount and character of the insoluble residue were examined. The results of these data will be discussed in the text to follow.

Table 1. Geologic Data from selected wells in Hernando, Hillsborough, Pasco, Pinellas, and Sumter Counties

Bureau of Geology W-No.	Well Number this report	Depth in feet to Top of Geologic Formation				
		Surface Elevation	post Oligocene Clastics	post Suwannee limestone	Suwannee limestone	Crystal River Formation
HERNANDO COUNTY						
6234	WHr-21S-18E-15ab	121.0	0.0	0.0	10.0	60.0
274	WHr-21S-19E-36ca	261.0	0.0	76.0	100.0	198.0
7766	WHr-22S-17E-3cc	8.0	0.0	—	20.0	45.0
7764	WHr-22S-17E-5aa	8.0	0.0	—	—	8.0
7765	WHr-22S-17E-9aa	9.0	0.0	—	—	9.0
7439	WHr-22S-17E-28ca	7.0	0.0	—	15.0	30.0
7768	WHr-22S-18E-29cc	36.0	0.0	—	42.0	55.0
2876	WHr-22S-19E-6ad	55.0	0.0	—	—	25.0
4697	WHr-22S-19E-11dc	93.0	0.0	18.0	25.0	95.0
10306	WHr-22S-19E-21dd	129.0	0.0	—	5.0	100.0
5608	WHr-22S-19E-34ba	144.0	0.0	—	70.0	144.0
4205	WHr-22S-20E-19bc	128.0	0.0	—	5.0	93.0
7737	WHr-22S-21E-8dd	55.0	0.0	—	—	30.0
5759	WHr-22S-21E-15ac	57.0	0.0	—	—	21.0
10464	WHr-22S-21E-32cc	79.0	0.0	—	70.0	130.0
7763	WHr-23S-16E-25bd	8.0	0.0	—	8.0	120.0
7767	WHr-23S-17E-2bb	23.0	0.0	—	28.0	46.0
10356	WHr-23S-17E-28	34.0	0.0	—	50.0	120.0
10354	WHr-23S-18E-21dc	62.0	—	—	10.0	140.0
707	WHr-23S-19E-18cc	68.0	—	—	25.0	105.0
8357	WHr-23S-19E-35db	98.0	0.0	—	15.0	—
5694	WHr-23S-20E-3aa	118.0	0.0	—	30.0	130.0
1442	WHr-23S-20E-12bb	160.0	0.0	40.0	90.0	170.0
6556	WHr-23S-20E-17dd	107.0	0.0	—	30.0	150.0
8426	WHr-23S-20E-32ad	139.0	0.0	35.0	40.0	200.0
PASCO COUNTY						
10298	WPs-23S-21E-19ca	105.0	0.0	—	70.0	—
6470	WPs-23S-21E-22cd	81.0	0.0	—	60.0	70.0
7801	WPs-23S-22E-26ac	82.0	0.0	—	—	15.0
3357	WPs-24S-16E-27cc	8.0	0.0	4.0	10.0	—
5271	WPs-24S-16E-34dc	8.0	0.0	—	15.0	—
7463	WPs-24S-18E-1	66.0	0.0	25.0	30.0	—
8318	WPs-24S-18E-35cb	89.0	0.0	—	60.0	240.0
2199	WPs-24S-20E-11bd	251.0	0.0	90.0	130.0	—
8507	WPs-24S-20E-35bc	192.0	0.0	—	120.0	230.0
8840	WPs-24S-21E-15ba	76.0	0.0	60.0	85.0	135.0
2707	WPs-24S-21E-28bb	114.0	0.0	—	70.0	170.0
6504	WPs-24S-21E-33bd	137.0	0.0	—	46.0	—
3805	WPs-25S-16E-4ad	48.0	0.0	42.0	120.0	—
7464	WPs-25S-17E-5bc	31.0	0.0	—	25.0	—
7405	WPs-25S-17E-12ad	55.0	0.0	—	47.0	—
7403	WPs-25S-17E-29ad	36.0	0.0	40.0	60.0	—
7465	WPs-25S-19E-7bd	82.0	0.0	30.0	40.0	—
7419	WPs-25S-19E-12bd	85.0	0.0	—	70.0	—
5865	WPs-25S-20E-11dd	121.0	0.0	—	50.0	140.0

Table 1. Continued

Bureau of Geology W-No.	Well Number this report	Surface Elevation	post Oligocene Clastics	post Suwannee limestone	Suwannee limestone	Crystal River Formation
7466	WPs-25S-20E-26ba	125.0	0.0	50.0	80.0	—
5282	WPs-25S-21E-8db	127.0	0.0	—	40.0	130.0
2160	WPs-25S-21E-22db	226.0	0.0	—	136.0	—
5350	WPs-25S-22E-28dc	89.0	0.0	—	19.0	35.0
10471	WPs-26S-15E-36dd	16.0	0.0	38.0	135.0	—
1836	WPs-26S-16E-4ad	38.0	0.0	65.0	85.0	—
7411	WPs-26S-16E-24bc	36.0	0.0	20.0	95.0	—
7418	WPs-26S-18E-28db	60.0	0.0	55.0	80.0	295.0
6169	WPs-26S-18E-36aa	73.0	0.0	—	42.0	—
3434	WPs-26S-20E-35dd	67.0	0.0	—	45.0	175.0
3284	WPs-26S-21E-3db	82.0	0.0	60.0	65.0	160.0
2972	WPs-26S-21E-11ba	105.0	0.0	—	60.0	—
662	WPs-26S-21E-13aa	81.0	—	—	55.0	175.0
3512	WPs-26S-21E-27ba	70.0	0.0	—	20.0	60.0
SUMTER COUNTY						
7802	WSm-23S-23E-31ca	95.0	0.0	—	—	30.0
5054	WSm-24S-23E-31bb	97.0	0.0	—	—	7.0
PINELLAS COUNTY						
2526	WPi-27S-16E-11	23.0	0.0	55.0	100.0	350.0
HILLSBOROUGH COUNTY						
7032	WHl-27S-22E-6db	84.0	0.0	—	30.0	170.0

STRATIGRAPHY

OLIGOCENE SERIES

SUWANNEE LIMESTONE

HISTORICAL

Cooke and Mansfield (1936, p. 71) erected the name Suwannee Limestone and made the following statement:

"The name 'Suwannee limestone' is proposed for yellowish limestone typically exposed along the Suwannee River in Florida, from Ellaville, where it unconformably overlies white limestone containing Vicksburg

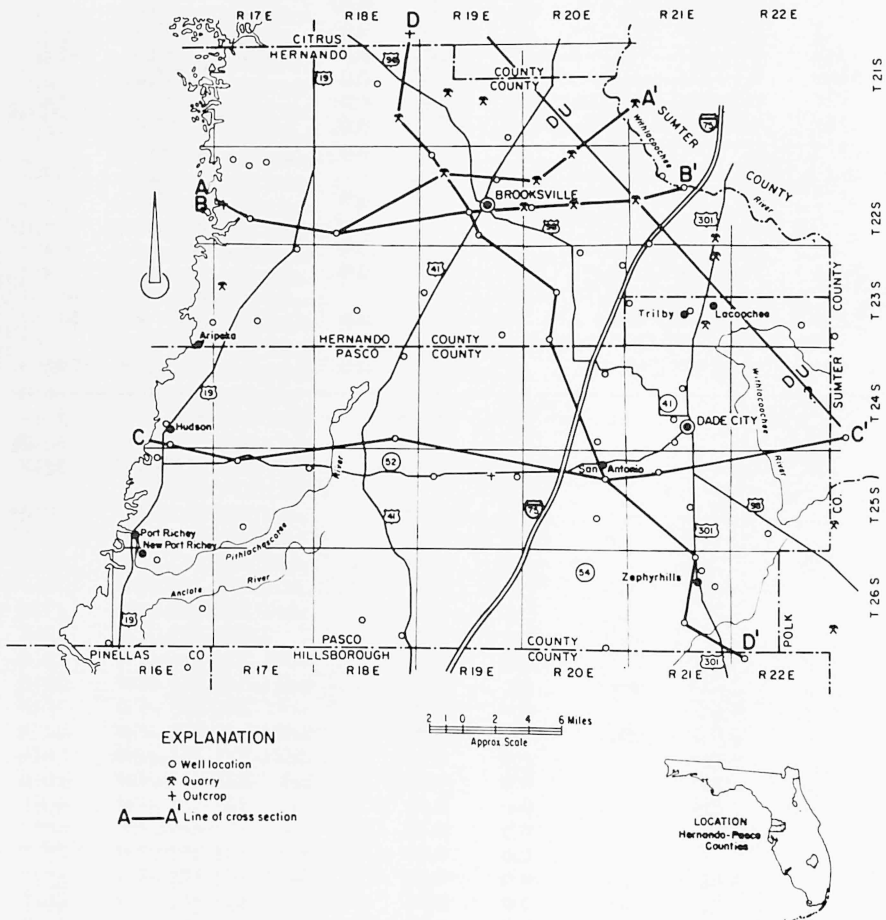


Figure 4. Location of wells, outcrops, quarries, and lines of section in Hernando and Pasco counties.

(Oligocene) fossils, almost to White Springs near which it lies unconformably below the Miocene Hawthorn formation. Another large area of Suwannee limestone, centering near Brooksville, Hernando County, lies between the Eocene Ocala limestone (on the north) and the Miocene Tampa limestone (on the south).

"Most writers have regarded the Suwannee limestone as part of the Tampa limestone. The writers think it is of late Vicksburg age, because it contains the echinoid *Rhyncholampas gouldii* (Bouve), which is known elsewhere only in the late Vicksburg Flint River formation, and several species of Flint River mollusks. The presence of a species of the foraminiferal genus *Coskinolina* (*C. cookei* Moberg) suggests an age older than Miocene. The Suwannee limestone is correlated tentatively with the Flint River formation of Georgia and with the Chickasawhay marl member of the Byram marl of Mississippi, which occupies the uppermost known horizon of the Vicksburg group."

Dall (1892, p. 121) did not consider Oligocene beds to be present in Florida and placed the limestones cropping out along the Suwannee River at Ellaville in his Tampa beds of Miocene age.

In their report of 1909 (p. 73-74) Matson and Clapp reported that specimens of the echinoid *Cassidulus* were obtained from cherty rocks that probably came from the channel of the Suwannee River at White Springs, Hamilton County. They also reported finding *Cassidulus* in cherty rocks at Croom, Hernando County. The close proximity of the *Cassidulus* bearing rocks to the Hawthorn Formation at White Springs led Matson and Clapp (1909, p. 73-74) to believe the *Cassidulus* zone occurred near the top of the Hawthorn and was of Miocene age.

Mossom (1925, p. 78-79) found *Cassidulus gouldii* (Bouve) in the Florida Rock Products pit just west of Brooksville, and he noted similarities between the faunal assemblage in the rocks at Brooksville and those in deposits he mapped as Glendon age in Hamilton and Suwannee counties. However, he (Mossom 1925, p. 78-79) felt the deposits at Brooksville were correlative with the Miocene age Tampa Formation occurring in the Tampa Bay Area and consequently placed them in the Tampa.

Later Mossom (1926, p. 182-183) correlated the deposits he mapped as Tampa in Hernando and Pasco counties and on the north side of Hillsborough Bay with similar deposits found in other parts of northern Florida, particularly those along the Suwannee River from Ellaville to White Springs. He placed all of them in the Miocene age Tampa Formation.

Cooke and Mossom (1929, p. 72-92) also mapped as Tampa the upper portion of the deposits described by Mossom in 1926. However, as shown in the following section they (Cooke and Mossom, 1929, p. 72) considered the lower portion of the section exposed at Ellaville to be Glendon age.

This section was measured by Cooke and Mossom in 1913 at the Seaboard Coast Line Railroad bridge below the confluence of the Withalacoochee River with the Suwannee River.

SECTION ON EAST BANK SUWANNEE RIVER OPPOSITE
ELLAVILLE

Pleistocene:	Feet
5. Upper part concealed; lower part is agillaceous yellow sand containing small pebbles; the top is level with rail at bridge	16.5
Unconformity:	Feet
Miocene; Tampa Limestone:	
4. Hard, cream-colored to yellow limestone resembling bed 3 but very massive and without bedding planes; <i>Cassidulus gouldii</i> Bouve very abundant	10.5
3. Hard, chalky-white to pink, compact, crystalline limestone; lower 2 feet appear to be brecciated; upper part is thin-bedded	4.0
Oligocene; Glendon limestone:	
2. Soft, white, marly limestone, indurated in places; contains a few Bryozoa and many fragments of <i>Chlypeaster rogersi</i> Morton?	2.0
1. White or creamy yellow compact limestone loaded with casts of mollusks (Station 6824); honey-combed by solution; extends to water level	5.5

Cooke and Mossom (1929, p. 78-92) further stated that the fossils in bed 1 of the preceding section is of Vicksburg age and correlated this bed with the Glendon limestone.

Mansfield (1937) described the mollusks from the Suwannee Limestone but suggested no change in terminology or age for the formation as he and Cooke (1936, p. 71) originally described it.

In 1944, MacNeil (p. 1317) reiterated the Oligocene age assignment to the Ellaville limestone beds; however, he reported that the gastropod *Turritella martinensis* occurred in the lower 7.5 feet and considered this lower unit to be lower Oligocene in age.

Cooke (1945, p. 86) suggested no change in the Suwannee deposits as previously mapped. However, he (Cooke, 1945, p. 85-86) did place the two lower beds of the section at Ellaville in the Byram Limestone which he and Mossom (1929, p. 72) had previously mapped as Glendon.

According to MacNeil (1946, p. 48-49; 1947) not only did the base of the Oligocene exposed at Ellaville contain *Turritella mar-*

tinensis but this fossil also occurred in a quarry near Martin Station [Martin Station is in Marion County, although MacNeil placed it in Hernando County] and in a quarry at Crystal River, Citrus County. As *Turritella martinensis* in eastern Mississippi occurs in the Mint Spring member of the Forest Hill Sand of lower Oligocene age, MacNeil (1946, p. 48-49; 1947) redefined the Suwannee limestone to include the Byram equivalent in western Florida and considered the zone of northern and peninsula Florida to be a basal member.

In discussing the Suwannee Limestone exposed at the Crystal River Rock Company Quarry at Crystal River, Florida, Vernon (1951, p. 175) stated: "Since the lower section of the interval assigned to the Suwannee limestone (beds 7 to 12) contains molds of mollusks found elsewhere in the Byram formation, the Forest Hill sand and the Suwannee limestone, there is a possibility that the section at Crystal River Rock Company quarry represents a time interval of the entire Oligocene epoch, and in this respect corresponds to the usage of the term, Suwannee limestone, in Holmes and Washington counties, Florida (Vernon, 1942). Since these basal beds, numbers 7 through 12, have been identified in Citrus County only at locality C-64 and possibly at C-108, pages 170-171, it was impossible to map those beds separately and they have been included with the Suwannee limestone.

As used in this report the Suwannee limestone includes all beds of Oligocene age in Citrus and Levy counties. The upper part of the formation is considered to be the equivalent of the lower Chickasawhay marl of eastern Mississippi, and the lower part possibly the equivalent of the Byram formation and Marianna limestone of western Florida."

PRESENT USAGE

The Suwannee Limestone as used in this report consists of all beds in Hernando and Pasco counties identified as Oligocene in age that overlie the Crystal River Formation and underlie post-Oligocene deposits. *Distribution:* Most of Hernando and Pasco counties are underlain by the Suwannee Limestone. The exceptions are a triangularly shaped area in the northwestern portion and a strip bordering the Withlacoochee River on the eastern side of Hernando County and a triangular area in the northeastern portion of Pasco County (see figure 5). In the areas where the Suwannee is missing the Crystal River Formation lies below post-Oligocene clastics.

The Suwannee lies very near the surface and in places crops out along the coast from Hudson, Pasco County to Bayport, Hernando County.

The altitude and distribution of the Suwannee Limestone in the central and eastern portions of Hernando County (fig. 5) were determined using scattered well data and outcrop data. As depicted on the

contour maps of the top of the Suwannee (fig. 5, figure 6) and in the stratigraphic cross sections (figure 7), the top of the Suwannee is very irregular.

The Suwannee Limestone in Pasco County, for the most part, occurs in the subsurface. The possible exception to this is the northwestern and eastern portions of Pasco County where it is reported (Carr and Alverson, 1959) to crop out. The authors were unable to verify this.

LITHOLOGY

The Suwannee Limestone in the area of study is a marine, bioclastic limestone which can be described as follows:

1. Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, firmly to weakly cemented with calcite, sandy (very fine to fine), may contain small amounts of silt and clay, moderate to high intergranular and macromoldic porosity, generally very microfossiliferous, commonly containing *Coskinolina floridana*, *Discorinopsis gunteri*, *Rotalia mexicana*, and molds of mollusks.
2. Crystalline limestone (calcarenite), very pale orange, very finely crystalline, firmly cemented with calcite (hard), sandy (very fine to fine), slightly silty and clayey, low to moderate

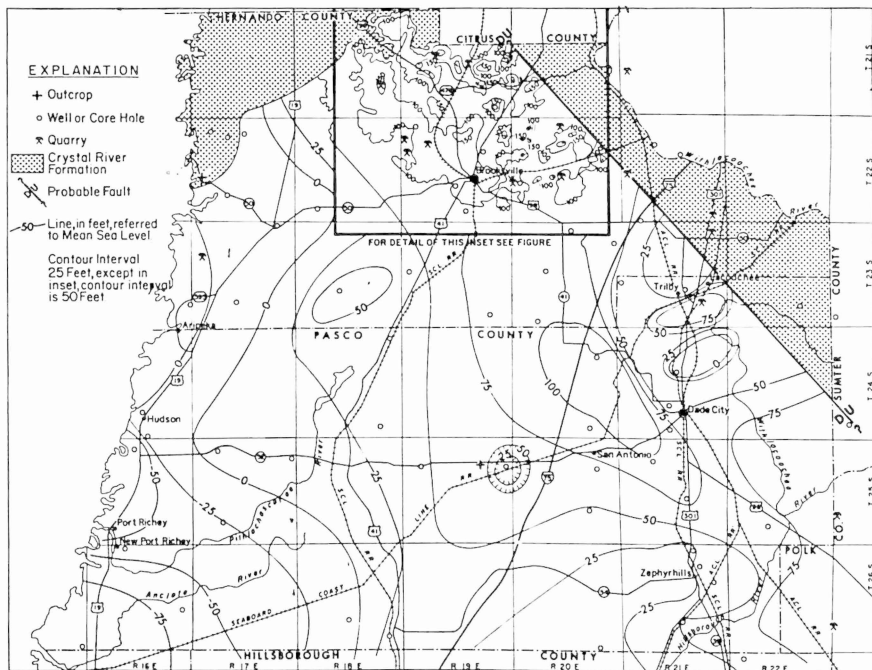


Figure 5. Contours showing approximate altitude of the top of the Suwannee Limestone in Hernando and Pasco counties.

moldic porosity, generally very microfossiliferous, commonly containing *Coskinolina floridana*, *Discorinopsis gunteri*, *Rotalia mexicana* and molds of mollusks.

3. Crystalline limestone (calcarenite), very pale orange, very finely crystalline, very firmly cemented with calcite (hard), sandy (very fine to fine), more silty and clayey than previously described No. 2, low to moderate moldic porosity, generally very microfossiliferous, contains miliolids, *Rotalia mexicana*, and molds of mollusks common.

The crystalline limestones (calcarenite), pictured in figure 8 and described as units two and three under Lithology, seem to be related to the subsurface high that trends northwest and southeast through Hernando and Pasco Counties (see figures 5, 6, and 7). This conclusion is supported by the absence of the crystalline limestone (units two and three under Lithology) in the subsurface low areas on the western side of Hernando County where only partially recrystallized limestone occurs. The rock in the upper part of the Suwannee

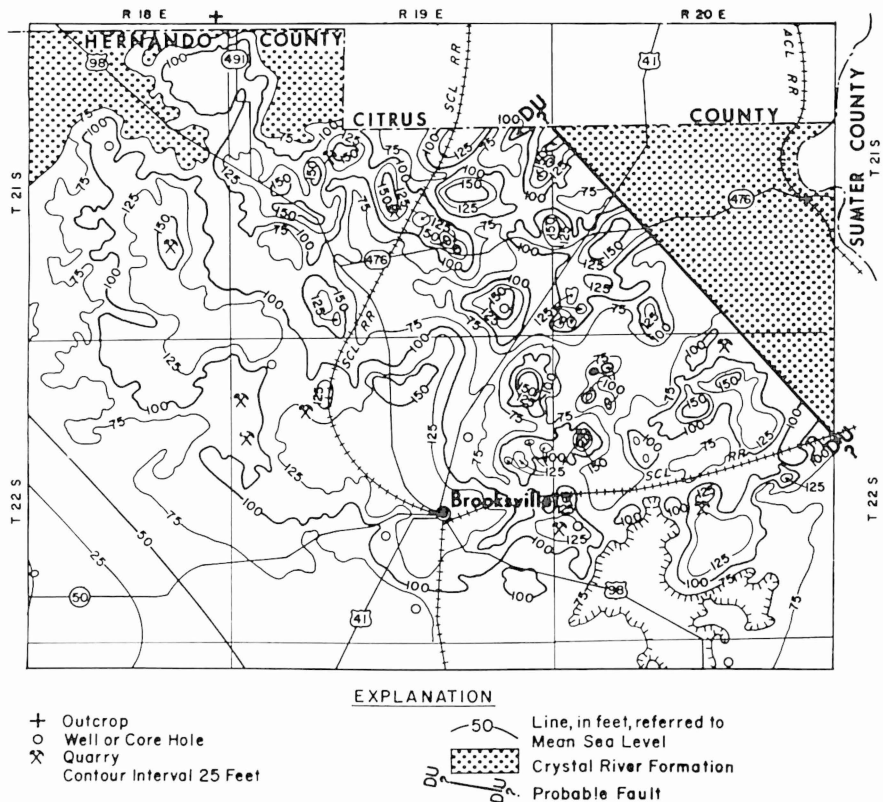


Figure 6. Detailed contours showing approximate altitude of the top of the Suwannee Limestone in northern Hernando County.

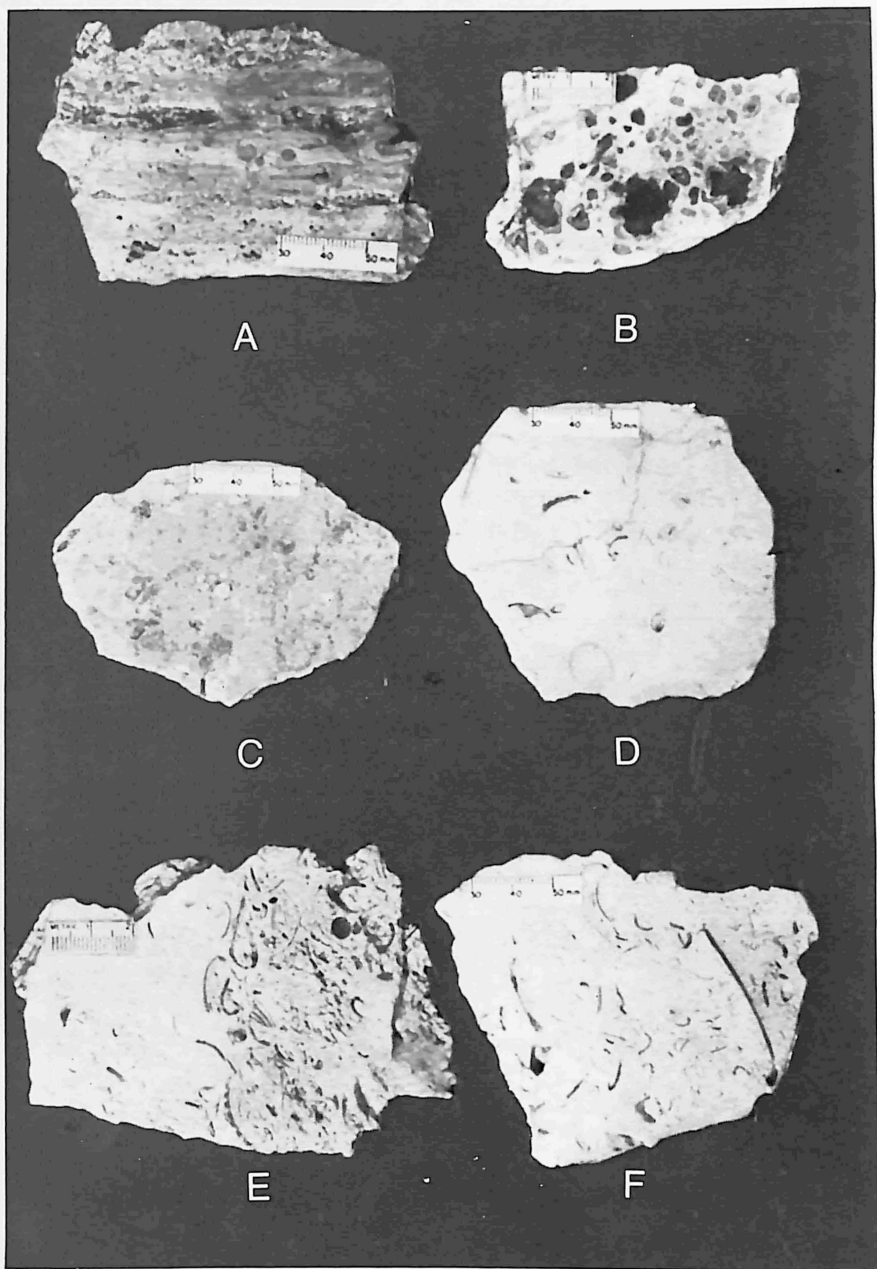


Figure 8. A. Suwannee Limestone, from McLeod Quarry, Pasco County, showing hard and soft beds.
B. Post Suwannee limestone, from Camp Concrete and Rock Company Quarry, Hernando County, showing dark angular fragments in a calcilutite matrix.
C-F. Crystalline Suwannee Limestone, from Camp Concrete and Rock Company Quarry, Hernando County. D-F show cross sections of mollusks.

section appears to contain finer grained carbonate particles, but not enough to be called a calcilutite and contains more insoluble material. In describing the lithology of the Suwannee deposits from water-well cuttings the writers made particular note of the wells which contained crystalline limestone (see Table 2).

Another observation made from studying the well cuttings that contain crystalline limestone was the absence of the soft carbonate material that was seen interbedded with the calcarenites in the quarry sections. It may be that the interbedded softer material was washed away during the drilling of the wells.

The Suwannee Limestone seen in the quarries around Brooksville and at McLeod quarry in Pasco County has alternating hard and

Table 2. Wells in Hernando and Pasco Counties which contain Crystalline Limestone

Bureau of Geology W-No.	Well Number this report	Surface Elevation	Depth to top of post Suwannee Crystalline limestone	Depth to top of Suwannee Crystalline Limestone	Thickness of Crystalline Limestone
HERNANDO COUNTY					
274	WHr-21S-19E-36ca	261.0	76.0	100.0	21.0
4697	WHr-22S-19E-11dc	93.0	18.0	25.0	10.0
10306	WHr-22S-19E-21dd	129.0	—	5.0	20.0
5608	WHr-22S-19E-34ba	144.0	—	70.0	15.0
4205	WHr-22S-20E-19bc	128.0	—	25.0	20.0
8357	WHr-23S-19E-35db	98.0	—	15.0	20.0
5694	WHr-23S-20E-3aa	118.0	—	30.0	20.0
1442	WHr-23S-20E-12bb	160.0	40.0	90.0	30.0
6556	WHr-23S-20E-17dd	107.0	—	30.0	35.0
8426	WHr-23S-20E-32ad	139.0	35.0	40.0	30.0
PASCO COUNTY					
10298	WPs-23S-21E-19ca	105.0	—	70.0	unknown
6470	WPs-23S-21E-22cd	81.0	—	60.0	5.0
8318	WPs-24S-18E-35cb	89.0	—	60.0	20.0
2199	WPs-24S-20E-11bd	251.0	—	130.0	50.0
8507	WPs-24S-20E-35bc	192.0	—	120.0	10.0
8840	WPs-24S-21E-15ba	76.0	60.0	85.0	40.0
7405	WPs-25S-17E-12ab	55.0	47.0	52.0	9.0
7403	WPs-25S-17E-29ad	36.0	40.0	43.0	15.0
5865	WPs-25S-20E-11dd	121.0	47.0	50.0	10.0
5282	WPs-25S-21E-8db	127.0	—	40.0	20.0
2160	WPs-25S-21E-22db	226.0	—	136.0	14.0

soft beds of varying thicknesses. During weathering the softer material which has some characteristics of a calcilutite erodes away and the harder beds stand out. Differential compaction and subsequent slump of the formation disrupts the harder beds of rock and gives them the appearance of being rubbly (figure 9). Generally, throughout the quarries thin seams and beds of clay occur in the limestone. In most of the quarries chert nodules and thin beds of chert are associated with the limestone. In the Lansing Quarry, Hernando County, a massive chert bed up to one foot thick occurs near the base of the Suwannee. As observed by the writers and reported by Ketner and McGreevy (1959, p. 57) a rubble of silicified Suwannee Limestone overlies the Crystal River Formation in the hard-rock phosphate belt along the eastern side of Hernando County.

According to Ketner and McGreevy (1959, p. 58) three samples of Suwannee Limestone collected from the McDonald Limestone quarry (sec. 19, T22S, R20E-Hernando County) and a hard-rock phosphate pit (sec. 18, T22S, R21E-Hernando County) contain less than 0.2 percent P_2O_5 and less than 0.1 percent Al_2O_3 . The writers found all quarry samples and well cuttings from the Suwannee Limestone to be phosphatic, however, no attempt was made to determine the percent of phosphate in the samples.

Chemical analyses of samples from four quarries in the Brooksville area indicate the Suwannee Limestone contains from 92.41 per-

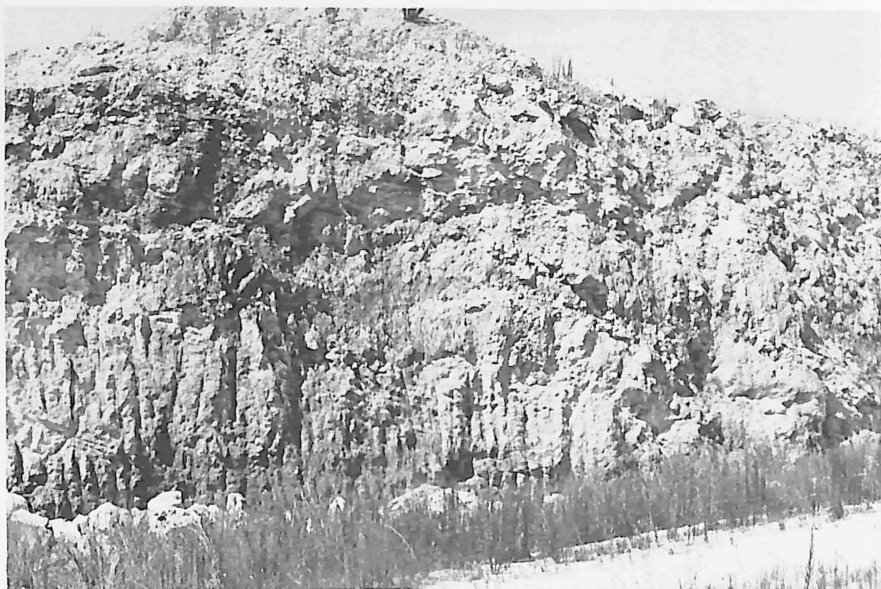


Figure 9. View showing bedding and rubbly nature of Suwannee Limestone.

cent to 99.56 percent calcium carbonate. The insoluble residue portion of these samples consisted of quartz sand, silt and clay along with a trace of heavy minerals. The quartz sand is very fine to fine grained, predominantly subangular with some subrounded grains.

Figure 10 graphically depicts the relative quantities of insoluble residue (sand, clay and silt) found in samples obtained from the four quarries in the Brooksville area. Note that the amount of insoluble material decreases downward in the Suwannee Limestone. There are two zones where the amount of insoluble material is the greatest, one 0-10 feet below the top of the Suwannee and the other 29-43 feet below the top. In the Lansing Quarry the amount of insoluble residue drops significantly from 42 feet below the top of the Suwannee down to the contact with the Crystal River Formation. In wells WPs25S-19E-12bd and WPs24S-18E-1 in Pasco County peat is incorporated in the limestone near the base of the formation. In wells WPs26S-21E-13aa, WPs26S-18E-28db and WPs24S-18E-35cb, also located in Pasco County, the base of the Suwannee sediments contains dolomite as well as peat.

THICKNESS

The thickness of the Suwannee Limestone in portions of Hernando County is variable because of the karst surface developed on its top. The stratigraphic cross sections (fig. 7) give some idea as to the thickness of the formation. A-A' indicates that the Suwannee Limestone on the western side of Hernando County may be 12-15 feet thick. It thickens to as much as 110 feet in the central portion and thins again on the eastern side of Hernando County. Section B-B' shows that the Suwannee varies from 0 to 95 feet in thickness. Section D-D', a northwest-southeast cross section through Hernando and Pasco counties, shows the Suwannee to be 160 feet thick near the Hernando-Pasco county line. Section C-C' through Pasco County shows the Suwannee to thicken westward, and it may be up to 175 feet thick. In well WPs26S-18E-28db near the boundary of Pasco-Hernando counties the Suwannee Limestone is 215 feet thick and probably approaches the maximum thickness for the formation in the two counties.

Stratigraphic cross section A-A' and D-D' indicates that the crystalline limestone is thick in the upper and central portion of Hernando County but in section D-D' from Brooksville southward it begins to thin appreciably.

The relationship of the thickness of the crystalline limestone portion to the partially recrystallized limestone portion of the Suwannee

Limestone, as shown on the stratigraphic cross sections is based on several factors:

1. Observation and examination of the rocks occurring in the quarries.
2. Study of well cuttings.
3. Projections of the above observations into areas of no data based on a combination of the two.

GEOLOGIC SECTIONS

The following geologic sections are those used in preparing the stratigraphic cross sections and the contour maps used in this report:

Citrus County:

1. Locality LC20S-18E-36ca (Vernon, 1951, p. 170-180): In a limestone pit 3.4 feet of crystalline limestone (calcarenite) overlies the Crystal River Formation of Eocene age.

Hernando County:

1. Locality LHr22S-19E-8ac: The following description is of samples taken from the north face of a quarry operated by Camp Concrete and Rock Company located in the NW1/4, SW1/4 sec. 8, T22S, R19E.

<i>Sample No.</i>	<i>Description</i>	<i>Depth in feet from top of Quarry Face</i>
post Suwannee limestone		
1	Partially recrystallized limestone (calcilutite), yellowish gray, finely crystalline in part, firmly cemented with calcite, earthy appearance, sandy (very fine to fine), silty, clayey, manganese stained, contains pockets of clay, moderate to low intergranular porosity, no fossils noted, trace of heavy minerals.	0
2	As above, but contains pockets filled with moderate-yellowish brown chert. This rock has the appearance of being brecciated.	4
3	As above, but contains pale yellowish brown pebbles of crystalline dolomite, pockets of pale green clay present.	8
4	Same as No. 1 and contains chert pockets, phosphatic and perhaps finer grained and harder.	12
Oligocene Series		
Suwannee Limestone		
5	Crystalline limestone (calcarenite), very pale orange to pale yellowish brown, finely crystalline, very firmly cemented with calcite (hard), sandy (very	16

Sample No.	Description	Depth in feet from top of Quarry Face
	fine to fine), silty and clayey, low cavernous porosity, slightly microfossiliferous.	
6	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, firmly cemented with calcite, sandy (very fine to fine), silty and clayey, low intergranular porosity, microfossils noted in matrix, macromoldic.	20
7	As above.	24
8	As above.	28
9	Crystalline limestone (calcarenite) very pale orange, very finely crystalline, very firmly cemented with calcite (hard), contains slight amount of very fine to fine sand, silty and clayey.	32
10	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, very firmly cemented with calcite (hard), sandy (very fine to fine), silty and clayey, low moldic and cavernous porosity, microfossiliferous- <i>Rotalia mexicana</i> identified, macromoldic.	36
11	As above, but more macromoldic, thusly giving it moderate moldic porosity, <i>Turritella</i> sp. identified.	40
12	Same as No. 10, but contains less macrofossils- <i>Rotalia mexicana</i> present.	44
13	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to fine), silty and clayey, moderate to low moldic and cavernous porosity, slightly macromoldic.	48
14	As above.	52
15	As above.	56
16	Partially recrystallized limestone (calcarenite), very pale orange, very fine to finely crystalline in part, cemented firmly with calcite (hard), contains slight amount of very fine, angular sand, silty and clayey, contains zones of yellowish brown chert, moderate intergranular porosity, very microfossiliferous, also macrofossiliferous.	60
17	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented with calcite (hard), contains small amount of very fine to fine sand, silty	64

<i>Sample No.</i>	<i>Description</i>	<i>Depth in feet from top of Quarry Face</i>
	and clayey, intergranular, cavernous and moldic porosity, microfossiliferous.	

The section exposed here shows a series of alternating hard with thinner softer beds that have weathered to a very nodular appearing limestone. Lenses, blebs and pockets of green clay occur in the limestone throughout the quarry. Large boulders of brecciated appearing rock occur on the quarry floor (figure 11) which come from the post-Suwannee limestone exposed at the top of the quarry face.

2. Locality LHR21S-18E-23dd: The following description is of samples taken from the north face of the quarry operated by Brooksville Rock Company located in the SE1/4 SE1/4 sec. 23, T21S, R18E.

post-Suwannee limestone

- 1 Partially recrystallized limestone (calcilutite), light gray, finely crystalline in part, cemented with calcite (hard), sandy (very fine to fine), silty, clayey, manganese stained, moderate intergranular porosity, 3.0



Figure 11. Boulders of ?brecciated limestone from near contact of post Suwannee limestone and Suwannee Limestone at Camp Concrete and Rock Company Quarry, Hernando County.

Sample No.	Description	Depth in feet from top of Quarry Face
	very rubbly appearance and contains pockets, blebs and lenses of green clay.	
2	As above, contains molds of gastropods.	6.0
3	As above, appears to be very silty.	10.5
Oligocene Series		
Suwannee Limestone		
4	Crystalline limestone (calcarenite), very pale orange to pale yellowish brown, very-finely crystalline, cemented with calcite (very hard), contains less sand, silt and clay than above, low cavernous porosity, microfossiliferous, but nondistinctive because of recrystallization, macrofossiliferous- <i>Rhyncholampas gouldii</i> identified. This sample has the appearance of being brecciated, however, the smaller, very pale orange angular fragments within the pale yellowish brown matrix may be a product of recrystallization rather than deposition. Sediments are more massive than material above and forms a distinct ledge.	11.2
5	As above.	14.3
6	Crystalline limestone (calcarenite), very pale orange to pale yellowish brown, finely crystalline, cemented with calcite (hard), sandy (very fine to fine), silty and clayey as above, low cavernous porosity, contains scattered pockets of sand-size particles, intense recrystallization makes identification of microfossils impossible; limestone weathers to give the sediments a rubbly, nodular appearance.	17.6
7	As above, but predominantly very pale orange, cemented firmly with calcite (hard), (if fossils present recrystallization has destroyed them.)	23.0
8	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, cemented with calcite (firm), sandy (very fine to fine), silty and clayey, moderate to high intergranular porosity, very microfossiliferous, abundant 'cones'- <i>Coskino-lina floridana</i> identified, miliolids, macromoldic.	37.0
9	As above, but weakly to firmly cemented with calcite, pale yellowish orange.	41.0
10	Same as No. 8, predominantly recrystallized but also crystalline in part. <i>Sorites</i> sp. identified.	44.0
11	Partially recrystallized limestone (calcarenite), very	46.0

Sample No.	Description	Depth in feet from top of Quarry Face
	pale orange, manganese and iron stained, cemented firmly with calcite, silty and clayey as above, microfossiliferous, 'cones' and miliolids.	
12	Same as No. 8	49.0
13	Same as No. 10, perhaps more crystalline.	52.0
14	Same as No. 10.	54.5
15	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented firmly with calcite (hard), sandy (very fine to fine), silty and clayey as above, moderate intergranular and moldic porosity, microfossiliferous and macromoldic- <i>Rhyncholampus gouldii</i> identified.	57.5
16	Crystalline limestone (calcarenite), grayish orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to fine), silty and clayey as above, low moldic and cavernous porosity, microfossiliferous but fossils have been obscured by recrystallization.	60.0
17	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, cemented with calcite (firm), sandy (very fine to fine), silty and clayey as above, high intergranular porosity, microfossiliferous- <i>Coskinolina floridana</i> identified, macromoldic.	63.0
18	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, weakly to firmly cemented with calcite, sandy (very fine to fine), silty and clayey, high intergranular porosity, microfossiliferous- <i>Coskinolina floridana</i> and <i>Discorinopsis gunteri</i> identified, macromoldic.	67.5
19	As above.	72.5

The section exposed here shows a series of alternating hard and soft rubbly beds of varying thickness. Some blebs and pockets of green clay occur in the section.

3. Locality LHR21S-19E-17cd: In an abandoned quarry of the Florida Rocks Products Company, on the east side of a paved road, varying thicknesses of crystalline limestone (calcarenite) are exposed. The Suwannee exposed here is a series of hard and soft beds that have weathered to a nodular appearing limestone.
4. Locality LHR21S-19E-22a: The following descriptions of samples from the Lansing quarry were taken in a discon-

Sample No.	Description	Depth in feet from top of Quarry Face
tinuous section from the center and the northwest faces of the most westerly pit as well as from the north face of the central pit. The quarry is located in S1/2 NW1/4 sec. 22, T21S, R19E.		
post-Suwannee limestone		
1	Crystalline limestone (calcilutite), pale orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to medium — some coarse grains), very silty and clayey, moderate intergranular porosity, no fossils observed.	0
2	As above, contains fine to medium grained sand.	5
3	Partially recrystallized limestone (calcilutite), very pale orange, finely crystalline in part to chalky, very weakly to firmly cemented with calcite, sandy (very fine to medium), clayey, silty, moderate intergranular porosity.	10
4	As above, perhaps less silty and clayey, some grayish brown chert present.	13
5	As above, no chert present.	15
Oligocene Series		
Suwannee Limestone		
6	Crystalline limestone (calcarenite), very pale orange, very fine to finely crystalline, cemented with calcite (hard), sandy (very fine), silty and clayey, moderate to low intergranular porosity, microfossiliferous- <i>Rotalia mexicana</i> identified, macromoldic.	18
7	As above, crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented firmly with calcite (hard), sandy (very fine), silty and clayey, moderate to low intergranular porosity, microfossiliferous.	23
8	Crystalline limestone (calcarenite), very pale orange, very fine to finely crystalline, very firmly cemented with calcite (hard), sandy (very fine to fine), silty and clayey, moderate intergranular porosity, microfossiliferous- <i>Sorites</i> sp. and <i>Rotalia mexicana</i> identified, macromoldic- <i>Kuphus incrassatus</i> identified.	28
9	Crystalline limestone (calcarenite), very pale orange, chalky to finely crystalline, soft to cemented hard with calcite, very sandy (fine), silty and clayey, mod-	33

Sample No.	Description	Depth in feet from top of Quarry Face
	erate to high intergranular porosity, macrofossiliferous- <i>Rhyncholampas gouldii</i> present.	
10	Same as sample No. 8.	42
11	Crystalline limestone (calcarenite), very pale orange, soft to firmly cemented with calcite, sandy (very fine to fine), silty and clayey, moderate to high intergranular porosity, microfossiliferous- <i>Rotalia mexicana</i> identified.	47
12	Crystalline limestone (calcarenite), same as above.	62
13	Crystalline limestone (calcarenite), orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to fine), silty and clayey, low intergranular porosity, microfossiliferous, macromoldic.	65
14	Partially recrystallized limestone (calcarenite), very pale orange, finely crystalline in part, firmly cemented with calcite, slightly sandy (very fine), silty and clayey, high intergranular porosity, microfossiliferous- <i>Coskinolina floridana</i> and <i>Discorinopsis gunteri</i> identified, macromoldic.	80
15	As above, but crystalline in part.	90
16	Same as No. 14 but softer.	104
17	As above, soft, friable, only slightly sandy (fine).	108
18	Chert Zone.	109
Unconformity		
Eocene Series		
Ocala Group		
Crystal River Formation		
19	Partially recrystallized limestone (calcarenite, almost a calcirudite), very pale orange, finely crystalline in part, firmly cemented with calcite, clayey, moderate intergranular porosity, microfossiliferous- <i>Lepidocyclus ocalanus</i> and <i>Gypsina globula</i> present. (Turritella Zone of Hunter as described under section on Paleontology)	110
20	As above, abundant echinoids <i>Rhyncholampas gouldii</i> present. (Turritella Zone of Hunter as described under section on Paleontology)	114
21	Partially recrystallized limestone (calcarenite almost a calcirudite), very pale orange, chalky to finely crystalline in part, firmly cemented with calcite, moderate intergranular porosity, microfossiliferous- <i>Lepidocyclus ocalanus</i> and <i>Gypsina globula</i> pres-	115

Sample No.	Description	Depth in feet from top of Quarry Face
	ent, abundant miliolids, algal fragments, macro-moldic.	
22	As above, a black mineral present in matrix (may be weathered glauconite), <i>Lepidocyclina ocalanus</i> and <i>Gypsina globula</i> present.	117
23	As above.	119
24	As above, contains abundant <i>Lepidocyclina ocalanus</i> and <i>Gypsina globula</i> present.	123
25	As above.	128
26	As above.	130

The section of Suwannee Limestone exposed here shows a series of alternating hard with thinner soft beds that have weathered to a very nodular appearing limestone. Beds, blebs and lenses of green clay occur in the post-Suwannee and Suwannee Limestone sections. At the contact of the Suwannee Limestone and the underlying Crystal River Formation a massive chert bed occurs and is up to one foot thick. This chert bed generally occurs throughout the quarry and provides a convenient marker for the base of the Suwannee Limestone. Several thinner chert beds occur above this one in the Suwannee Limestone.

5. Locality LHR22S-20E-4db: In an abandoned hard rock phosphate pit boulders of silicified Suwannee Limestone containing *Rhyncholampus gouldii* and boulders of crystalline, macromoldic limestone (calcarenite) overlie about ten feet of Eocene-Crystal River Formation which occurs as limestone pinnacles in the pit.
6. Locality LHR22S-20E-18ba: In an inactive quarry about 73 feet of crystalline to partially recrystallized limestone (calcarenite) is exposed. Clay pockets 25 to 30 feet thick occur in the section. The section exposed here shows a series of alternating hard and soft rubbly beds. Chert beds occur at the base of the quarry.
7. Locality LHR22S-20E-21db: The following descriptions are of samples taken from the north face of the quarry formerly operated by McDonald Corporation located in the SE1/4 NE1/4 sec. 21, T22S, R20E.

post-Suwannee limestone

- | | | |
|---|---|---|
| 1 | Partially recrystallized limestone (calcilutite), very pale orange, chalky to finely crystalline in part, cemented with calcite (hard), sandy (very fine to fine with some medium) silty and clayey, trace of heavy minerals, low to moderate intergranular porosity, | 0 |
|---|---|---|

Sample No.	Description	Depth in feet from top of Quarry Face
	microfossiliferous, however, recrystallization makes identification of the fossils difficult.	
2	As above, very sandy in part and contains medium size quartz grains.	3
3	As above, predominantly crystalline, not as sandy.	6
Oligocene Series		
Suwannee Limestone		
4	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented with calcite (hard), sandy, silty and clayey, manganese stained, low porosity, microfossiliferous, slightly macromoldic- <i>Rhyncholampas gouldii</i> present.	9
5	As above, but contains more clay.	12
6	Crystalline limestone (calcarenite), very pale orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to fine), silty and clayey, low to moderate moldic porosity, microfossiliferous- <i>Rotalia mexicana</i> identified, macromoldic.	15
7	As above, but more microfossiliferous.	18
8	As above.	21
9	Crystalline limestone (calcarenite), very pale orange to pale orange, very finely crystalline, cemented with calcite (hard), sandy (very fine to fine) silty and clayey, manganese stained, low intergranular and moldic porosity, slightly microfossiliferous- <i>Rotalia mexicana</i> present, macromoldic.	24
10	Same as No. 7 and No. 8. <i>Rotalia mexicana</i> present.	27
11	Sample as above with some pale blue green clay present.	31

The section exposed here shows a series of alternating hard and thinner soft beds that have been weathered to a very nodular appearing limestone. Throughout the quarry lenses and blebs of green clay occur in the limestone. Also apparent are steeply dipping beds, probably representing slump structures resulting from solution.

8. Locality LHR22S-21E-19ab: In an abandoned hard-rock phosphate pit six feet of crystalline limestone (calcarenite) overlies the Eocene-Crystal River Formation. The Crystal River occurs as pinnacles in the pit.

Pasco County:

1. Locality LPS25S-19E-11bc: 1.2 miles east of intersection of State Highway 583 and 52 on the south side of State Highway 52, partially recrystallized limestone (calcaren-

Sample No.	Description	Depth in feet from top of Quarry Face
	ite) containing <i>Rhyncholampas gouldii</i> lies upon the spoil bank of a shallow dug pit. The limestone was not observed in place but is believed to have come from the pit.	
2.	Locality LPs23S-21E-26a: The following section was measured in an abandoned quarry (known as McLeod Pit) located in NW1/4 sec 26, T23S, R21E.	

Beds	Description	Thickness in Feet
Oligocene Series		
Suwannee Limestone		
4A	Partially recrystallized limestone (calcarenite), light gray, chalky, finely crystalline in part, firmly cemented with calcite, sandy (very fine to fine), trace of heavy minerals, high intergranular porosity, microfossiliferous, abundant smooth ostracods present. The matrix of the rock contains pebbles of very pale yellowish brown, crystalline, hard, finely sandy calcarenite.	7.0

Bed 4A occurs on the north face of the quarry and may be stratigraphically equivalent to bed 4 below. Bed 4A is thin bedded and consists of alternating soft and hard beds varying in thickness from $\frac{1}{4}$ inch to 4 inches thick (fig. 7). Toward the bottom of bed 4A, the sediments become soft and massive.

Beds 1 through 4 below were measured on the west face, near the south end of the quarry.

4	Partially recrystallized limestone (calcarenite), very pale orange, chalky, finely crystalline in part, firmly cemented with calcite, sandy (very fine to fine), trace of heavy minerals, high intergranular porosity, microfossiliferous- <i>Rotalia mexicana</i> identified, macromoldic.	6.0
3	Crystalline limestone (calcarenite), very pale orange, finely crystalline, cemented with calcite (hard), sandy (very fine to fine), trace of heavy minerals, high intergranular porosity, microfossiliferous- <i>Rotalia mexicana</i> , very macromoldic. Bed contains clay inclusions ranging in size from blebs to large pockets.	2.0
2	Crystalline limestone (calcarenite), very pale orange, finely crystalline, cemented with calcite (hard), sandy (very fine to fine), trace of heavy minerals, high moldic and intergranular porosity, microfossil-	6.0

Beds	Description	Thickness in Feet
	iferous- <i>Rotalia mexicana</i> present, macromoldic- <i>Rhyncholampus gouldii</i> present.	
1	Crystalline limestone (calcarenite), very pale orange, finely crystalline, very firmly cemented with calcite, sandy (very fine to fine), trace of heavy minerals, high intergranular porosity, very microfossiliferous- <i>Rotalia mexicana</i> , <i>Sorites</i> sp. identified, macro-moldic, Bryozoa present.	4.0

Total Thickness

(Beds 1-4)

18.0

Polk County:

1. Locality LPo25S-23E-30ca: In a quarry on the east side of State Highway 471, 2.35 miles north of intersection with U. S. Highway 98, silicified boulders of Suwannee Limestone overlie the Crystal River Formation of Eocene Age.
2. Locality LPo26S-23E-30bc: Northwest of Kathleen, Polk County, about 25 feet of Suwannee Limestone is exposed in a test pit.

The following localities of Crystal River Formation of Eocene Age were used in preparing the stratigraphic cross sections and contour maps in this report:

Hernando County:

1. Locality LHR22S-17E-19ad: Crystal River Formation of Eocene Age exposed in the bank of a ditch on the east side of State Highway 595 just north of intersection of State Highways 50 and 595.
2. Locality LHR23S-21E-1bc: About three feet of Crystal River Formation of Eocene Age is exposed in an abandoned quarry located just north of State Highway 50 and 0.4 miles east of intersection of U.S. Highway 301.
3. Locality LHR22S-21E-36bc: About three feet of Crystal River Formation of Eocene Age is exposed in a small quarry 1.40 miles north of intersection of U. S. Highway 98 and State Highway 50 on the east side of U. S. Highway 301.

Sumter County:

1. Locality LSm21S-21E-19cd: In a quarry located north of State Highway 476, 0.7 miles east of the Withlacoochee River, Crystal River Formation of Eocene Age is being mined.

STRATIGRAPHIC RELATIONSHIPS

The Suwannee Limestone is known to be unconformable with the

older Crystal River Formation and the younger Hawthorn Formation in Citrus County (Vernon, 1951, p. 177). The top of the Crystal River Formation in the area of study is irregular (fig. 7) and appears to be unconformable with the overlying Suwannee Limestone.

At the Lansing Quarry the Suwannee is underlain by a massive chert bed of variable thickness that may represent an unconformity. Below the chert to the bottom of the quarry a limestone section occurs which has a different lithology and overall bedding characteristics that is different than those of the Suwannee Limestone. The lithology of the beds below the chert zone is similar to those deposits mapped elsewhere in the area as Crystal River (Ocala Limestone of Carr and Alverson, 1959) and because of this similarity they are placed in the Crystal River Formation.

Hunter (written communication, 1970) found several species of mollusks and echinoids (see *Turritella martinensis* zone under Paleontology) in the limestone that occurs from four to five feet below the chert bed which the writers place in the Crystal River Formation. These species are also reported from Jackson and Vicksburg sediments in Mississippi, as well as from the intermediate Forest Hill Sand-Red Bluff Clay sequence. In this same interval, Puri (personal communication, 1971) identified *Lepidocyclina ocalanus* and *Gypsina globula* of upper Eocene age. The discrepancy in the age of the fossils makes the dating of this four to five foot section uncertain, and additional work on the paleontology will be required before a definite age can be assigned to this interval.

According to Shannon (1967, p. 47) the upper portion of the Suwannee Limestone in the Brooksville area appears to be stratigraphically higher than the Suwannee elsewhere in the state. He based his conclusion in part on the occurrence of the cone-shaped foraminifer *Coskino-lina* which occurs at or near the contact with the Miocene in Jefferson County, Florida. However, at the Lansing Quarry it occurs 30 to 50 feet below the contact with post-Suwannee sediments which he placed in the Miocene.

The writers found that *Coskino-lina floridana* is absent in the upper portion of the Suwannee at the Lansing quarry as well as in other areas of Hernando and Pasco counties. However, in the lower portion of the Suwannee *Coskino-lina* is very common.

Microscopic examination and chemical analyses of the rocks at Lansing indicate a change in the lithology about 18 feet below the first occurrence of limestone in the quarry. The grain size of the limestone changes from an overlying calcilutite downward to a calcarenite. The basal limestone conglomerate at the top of the Suwannee Limestone found at the Camp Quarry, (fig. 8-11) described by Randazzo (see Part II) and the writers, as well as the limestone conglomerate observed by the

writers at the Brooksville Rock Quarry, is not present at the Lansing Quarry. The absence of the limestone conglomerate makes the determination of the contact between the Suwannee and overlying fine grained limestone deposits at Lansing more difficult. However, the apparent absence of fossils, an upward change in the section from a calcarenite to a calcilutite and the influx of more clastic material in the upper ten feet of the section, indicates the depositional environment did change.

This uppermost post-Suwannee limestone unit (figure 12), also observed at the Brooksville, Camp, and McDonald quarries described from the deposits found along the subsurface high into Pasco County, is believed to be stratigraphically higher than the sediments described by the writers as Suwannee Limestone in Hernando and Pasco counties. The contact between this unit and the underlying Suwannee is believed to be unconformable based on the presence of the previously mentioned basal conglomerate, the apparent absence of fossils in the upper unit and a change in lithology.

Solution pipes and collapse features (sinkholes), formed on the Suwannee surface and apparent at the quarries around Brooksville (figure 13), are filled with clastic material of probable Miocene or younger age, indicating an unconformity between them and the Suwannee Limestone.

As illustrated in the contour maps (fig. 5 and 6) and in the series of stratigraphic cross sections (fig. 7) the top of the Suwannee Limestone is irregular and apparently unconformable with younger overlying deposits.

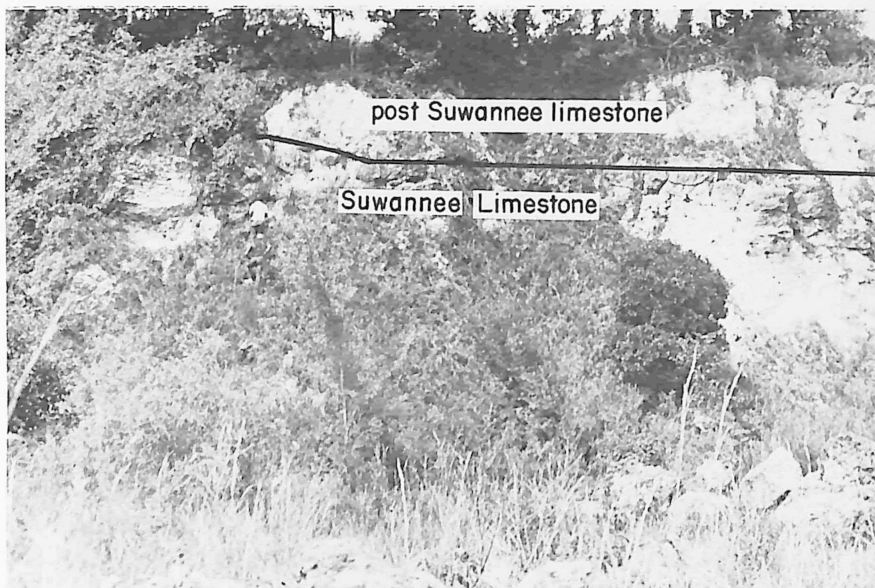


Figure 12. Contact of post Suwannee limestone and Suwannee Limestone at Brooksville Rock Company Quarry, Hernando County.



Figure 13. Filled sinkhole developed in Suwannee Limestone. Also note the bedded nature of limestone to right of sink.

PALEONTOLOGY

A detailed paleontological investigation was not carried out but diagnostic foraminifera described by other workers were noted through careful microscopic examination of samples collected from the area.

Many forms of mollusks occur in the Suwannee Limestone of the area. As reported by Carr and Alverson (1959, p. 11) the echinoid *Rhyncholampus gouldii* Bouve is very common and apparently a diagnostic macrofossil.

The mollusks of the Suwannee Limestone were described by Mansfield (1937). Those species that he (Mansfield, 1937, p. 48) considered to be characteristic of the formation are: *Orthaulax pugnax hernandoensis* Mansfield, *Ampullina flintensis* Mansfield, *Chlamys brooksvillensis* Mansfield, *Chione* aff. *C. bainbridgensis*, Dall, *Kuphus incrassatus* Gabb, and *Rhyncholampus gouldii* Bouve.

Hunter (written communication 1970) made the following comments on the macrofossils from various quarries in Hernando County:

1. Lansing Quarry:

"The following species of fossil invertebrates have been collected at the Lansing Quarry from rocks on the floor of the western most pit beneath the water tower. All are believed to have come from that part of the section exposed in this pit, which is above the upper ledge in the complete exposure of the Suwannee in the main pit.

- Echinoids: *Rhyncholampus gouldii*, Bouve (Abundant in the lowest beds)
Phymotaxis mansfieldi, Cooke (Rare)
- Mollusks: "Amauropsis" aff. *burnsii meridionalis*, Pilsbury
- (Gastropods) *Ampullina* cf. *flintensis*, Mansfield
 ?*Astrea* sp.
Calliostoma cf. *silicatum*, Mansfield
Cerithium aff. *vaginatum*, Dall
Cerithium hernandoensis, Mansfield
Cypraea sp.
Potamides cf. *cornutus*, Heilprin
Scaphander sp.
- (Bivalves) *Xenophora* sp.
Chama cf. *lyelli*, Dall
Phacoides hernandoensis, Mansfield
Trachycardium brooksvillense, Mansfield
- Corals: Abundant fragments of several species of fine branching corals, as well as other types are present. None were identified although it is possible that further study may indicate genus and species of one or more of the forms."

The following list with comments was provided by Hunter (1970) who collected the specimens just below the first ledge above the floor of the deepest and largest pit at the Lansing Quarry. She correlated this part of the section with the *Turritella martinensis* Zone of Mac Neil (1944).

- "Echinoids: *Clypeaster* aff. *rogersi*, Morton. This form has thinner margins and smaller petal area than *C. rogersi*.
Rhyncholampus gouldii, Bouve
- Mollusks: *Turritella* aff. *martinensis*, Dall (Exterior Molds)
Ostrea vicksburgensis, Conrad
Pecten sp. A (May be affiliated with *P. anatifipes*, but has 5 ribs instead of 4. Is badly worn.)
Pecten sp. B (aff. *P. perplanus perplanus*, Morton)
Pinna sp. (Interior Molds)
- Foraminifera: Two species of *Lepidocyclina* appear to be represented, as well as several other species.

'(1) The name and spelling *Rhyncholampus gouldii* for "*Cassidulus gouldii*" shown above is the accepted form, as recognized by Kier in his "Revision of the Cassiduloid Echinoids," 1962.

'(2) Well preserved specimens of *Ostrea vicksburgensis* collected at the Lansing pit agree in detail with specimens on hand from the Mint Spring marl in Mississippi. The species also is reported from the Red Bluff Clay-Forest Hill Sand sequence as well as the upper Jackson beds in that state.

'(3) The pectens all show varying degrees of wear. Species A is highly suggestive of *Pecten anatipes*, but certain identification requires better material. *P. anatipes* ranges from the Red Bluff Clay through the Byram Formation. Species B is probably a variety of *P. perplanus perplanus*. In the past much confusion has generated concerning these Eocene-Oligocene pectens, but recently published studies indicate that the small common form present in the Crystal River formation in Florida and equivalent beds elsewhere is *P. spillmani*. *P. perplanus perplanus* is found in the Red Bluff Clay; *P. perplanus poulsoni* in the Marianna limestone and Mint Spring Marl.

'(4) The species of the *Lepidocyclus* could possibly be determined, as structure is present in several on hand. These could be useful, as *Lepidocyclus chaperi* and *L. ocalanus* are present in the Red Bluff Clay and Bumpnose units, while *L. mantelli* is typical of Marianna Limestone. For micropaleontologists dependent on well samples, this difference in foraminifera might suggest a good boundary marker.

'The age of this zone and its more westerly equivalents is currently uncertain. Faunas in different areas contain both Eocene and Oligocene elements, suggesting that it may represent a transitional period. However, most of the literature I have seen shows the zone as "?Oligocene" in age."

2. Camp Quarry:

At the Camp Quarry located north of Route 50, west of Brooksville, Hunter (1970) says that "although the general appearance and brecciated condition of many of the rocks is suggestive of Tampa Limestone, no mollusks, limited to the Tampa Limestone, either marine or terrestrial, were seen. On the contrary, only species known to occur in the Suwannee Limestone were recognized.

'From float in the bottom of the upper level of the pit, between the wall opposite the access road and the pinnacle in the center of the quarry floor, the following were collected:

Rhyncholampus gouldii, Bouve One specimen in rock apparently from the fossiliferous bed discussed below.

Kuphus incrassatus, Gabb This species, while common in Oligocene beds, is also present in beds which have been reported as Tampa limestone.

'At the base of the west wall of the pit, facing the access road, are many large boulders which appear similar to beds exposed in the cut above them. Although most of these were hard, brecciated limestones containing fragments of varying sizes, rocks of one fossiliferous bed were noted. These contained molds of the following species:

Orthaulax hernandoensis, Mansfield

Cerithium hernandoensis, Mansfield

Cerithium cf. *brooksvillensis*, Mansfield (Interior mold)

Ampullina sp.

Turritella sp. (May be new species. Does not resemble any of those published in available literature.)

Chione cf. *bainbridgensis*, Dall

Trachycardium sp."

3. Florida Rock Products Quarry:

"A bed of hard limestone, containing *Orthaulax hernandoensis* and other Oligocene species is present near the top of the section, overlying a bed containing *Kuphus incrassatus*, at the Florida Rock Products Quarry on Route 98, northwest of Brooksville. While none of the brecciated beds were observed at this locality, similarity of the fossils present suggests that the two fossiliferous beds may be equivalent, and may provide a basis of correlation between the two quarries. At the Camp Quarry, this bed contains a tremendous number of *Orthaulax hernandoensis*, Mansfield. All specimens seen where the whorls of the spire were preserved, revealed no trace of callus covering. The spires of both *Orthaulax pugnax* of the Tampa Limestone, and *Orthaulax gabbi* of the Chipola Formation are covered by callus."

The writers found that the upper part of the Suwannee described as unit three under Lithology contains various genera of Foraminifera. However, the only forms the writer identified were *Rotalia mexicana* and *Sorites* sp. The lower part of the section described as units one and two under Lithology contains many Foraminifera. Some of these belong to the families Valvulinidae (*Coskinolina*) and Rotaliidae (*Discorinopsis* and *Rotalia*). According to Glaessner (1948, p. 185-186) Valvulinidae occurs at depths up to five fathoms (30 feet) with temperatures 20° to 31° C. and Rotaliidae may occur at all depths, but are very abundant at depths that range from 0 to 5 meters (0 to 16.5 feet) and temperatures ranging from 0 to 27° C. Henson (1950, p. 215-238) in his discussion of reef formations in the Middle East points out that Miliolidae, Valvulinidae and Rotaliidae are some of the foraminiferal faunas associated with what he calls fringing reefs and open shoal reefs.

Shannon (1967, p. 44) remarked that the fauna he described from near the top of the Suwannee deposits at Lansing Quarry occurred in waters 0 to 20 meters (0 to 65 feet) in depth and placed this interval in what Phleger (1960, p. 258-259) referred to as the near shore turbulent zone.

Mollusks are common throughout the Suwannee section. Hunter (1970) reports that corals and the mollusk *Orthaulax hernandoensis* are very abundant in the upper part of the Suwannee at the Camp Quarry and says that Vokes and Vokes (1968, p. 71-72) states that the genus *Orthaulax* lived in a coral environment as well as a low energy back reef environment.

STRUCTURE

The largest geological structure affecting the area of study is a broad gentle flexure called the Ocala Uplift (figure 14). According to Vernon (1951, p. 54-55) the Ocala Uplift is approximately 70 miles wide and 230 miles long and extends from northern Polk County, Florida to the Georgia border.

As pointed out in the following discussion the portion of the Ocala Uplift in Sumter County lying adjacent to Hernando County probably had a bearing on the configuration of the Suwannee deposits in the area of study.

The configuration and altitude of the Suwannee limestone is shown by the contour maps (fig. 5 and 6), and the stratigraphic cross sections (fig. 7) further illustrate the altitude of the beds.

The contour maps show that an elongated subsurface high extends from Pasco County northwestward into Hernando County. As shown on the insert on figure 6, the contours of that portion of the high in Hernando County show the Suwannee surface in much more detail.

The negative or subsurface low area between Dade City and Trilby, Pasco County was drawn on data from one well. It is probably a result of post-Suwannee erosion as the Suwannee is only 50 feet thick in this particular well.

The high area just south of Trilby may have been originally connected to the positive or high area to the west, but it has been separated by subsequent erosion. The altitude and thickness of the Suwannee Limestone in Hernando County (fig. 7) are such that by projecting its dip to the east the Suwannee should cover the peninsula. However, Suwannee deposits are absent on the eastern side of Hernando County and the northeastern edge of Pasco County. Vernon (1951, figure 13) pointed out that it does not occur above the crest of the Ocala Uplift east of Hernando County.

At the end of the Oligocene Epoch, gentle arching of the region began as the Ocala Uplift was initiated, and faulting occurred along the crest and flanks of the uplift. Carr and Alverson (1959, p. 59-60) and Pride and others (1966, fig. 9) propose the presence of a northwest-southwest trending normal fault in northwest Polk County. This structural movement may have caused the Eocene and Suwannee deposits along the eastern portion of Hernando County and the northeastern corner of Pasco County to become adjacent to one another (fig. 5, 6 and 7). As the uplift progressed, the Suwannee seas regressed and erosion removed that portion of the Suwannee deposited east of the fault cutting across Hernando and Pasco counties. The Suwannee deposits to the west of the fault were also subjected to erosion but were not totally removed.

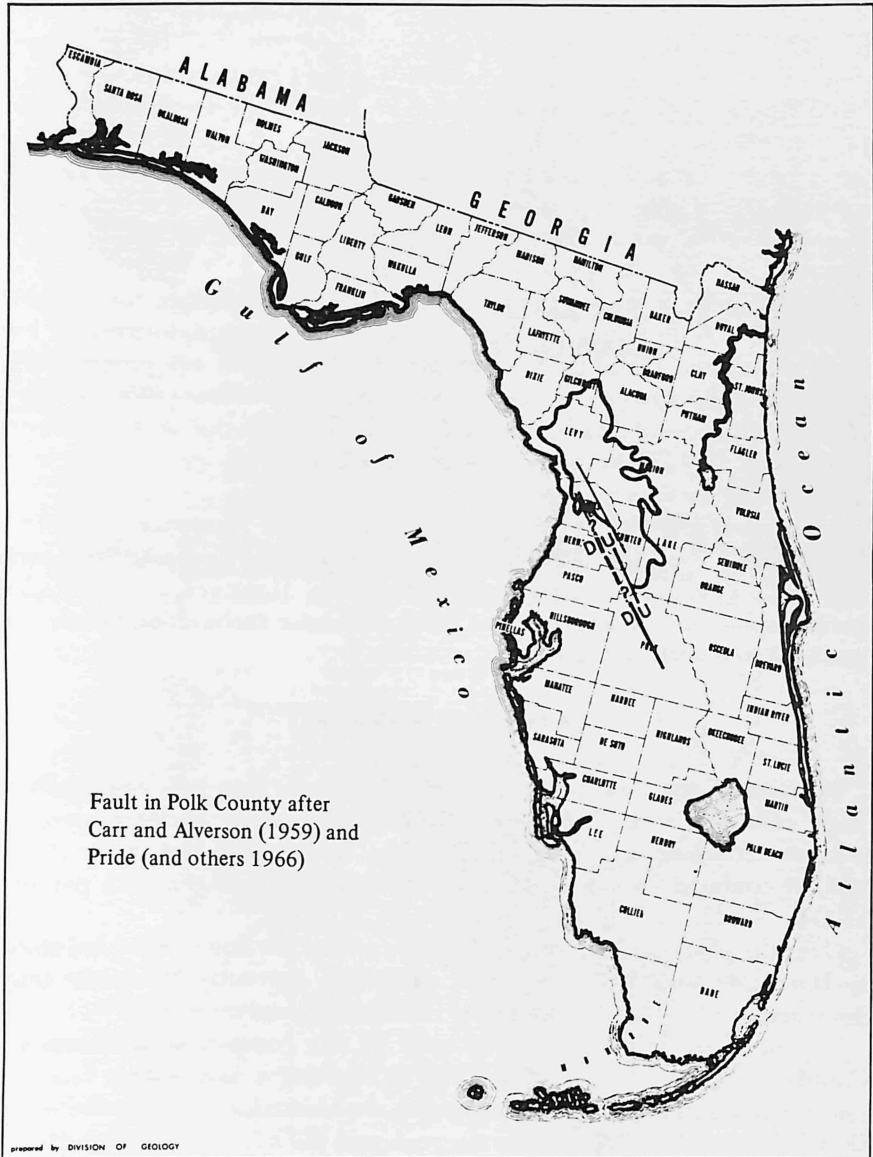


Figure 14. Map of Florida showing location of Ocala Uplift in a portion of Florida and related faulting (modified after Vernon, 1951).

GENERAL SUMMARY OF DEPOSITIONAL HISTORY

During the early stages of Suwannee deposition the environmental conditions in the area of study appear to be similar to those that occurred in the type area of the formation, along the upper Suwannee

River. This conclusion is substantiated by paleontological evidence, similar lithologies (except for detrital quartz sand found in the Suwannee deposits in the area of study) and similar bedding characteristics.

Detrital material is present throughout the section in the study area, with a greater influx of clastic sediments toward the latter stages of deposition. The peat associated with the carbonates in Pasco County suggests that during the early part of Suwannee time there was probably a very shallow, warm water environment where marine and plant life thrived.

Even though definite evidence is lacking, the subsurface topographic high (fig. 5, 6 and 7) may represent a carbonate bank formed on top of the Eocene-Crystal River Formation which built up progressively throughout the Oligocene. The predominance of calcarenites, bedding characteristics, and paleontological evidence leads the writers to conclude that the carbonate sediments associated with this feature were deposited in a warm shallow sea.

The environmental evidence inferred by the presence of corals, *Orthis*, *Miliolidae*, *Valvulinidae* and *Rotaliidae* indicate that reefs may have developed on the carbonate banks. However, more detailed petrographic and paleontological work will have to be done before this can be stated with certainty.

ECONOMIC GEOLOGY

Analyses of the Suwannee Limestone indicates that it is essentially a "high calcium" rock that ranges from 92.91 percent to 99.56 percent calcium carbonate, and as pointed out by Ketner and McGreevy (1959, p.58) it contains less than 0.2 percent P_2O_5 and less than 0.1 percent Al_2O_3 .

Over the years several companies have mined the Suwannee Limestone in Hernando and Pasco counties. However, currently there are only three active mines near Brooksville, Hernando County.

The open pit mining methods used by the companies in Hernando County are generally the same. Prior to opening a new quarry face the brush, trees, sand, and clay overburden are cleared away by bulldozing. Shot holes are then drilled into the rock and the quarry face is shattered by dynamite. The shattered rock is loaded by dragline onto trucks and transported to the rock crushers for processing (figure 15). Both the interbedded hard and soft layers are mined, but only the hard limestone is used. The soft layers and clay are washed away and stored in tailings ponds.

The geographic distribution of the Suwannee Limestone which the writers believe can be utilized for concrete aggregate is shown in figure 16. It should be pointed out that the area designated for potential con-

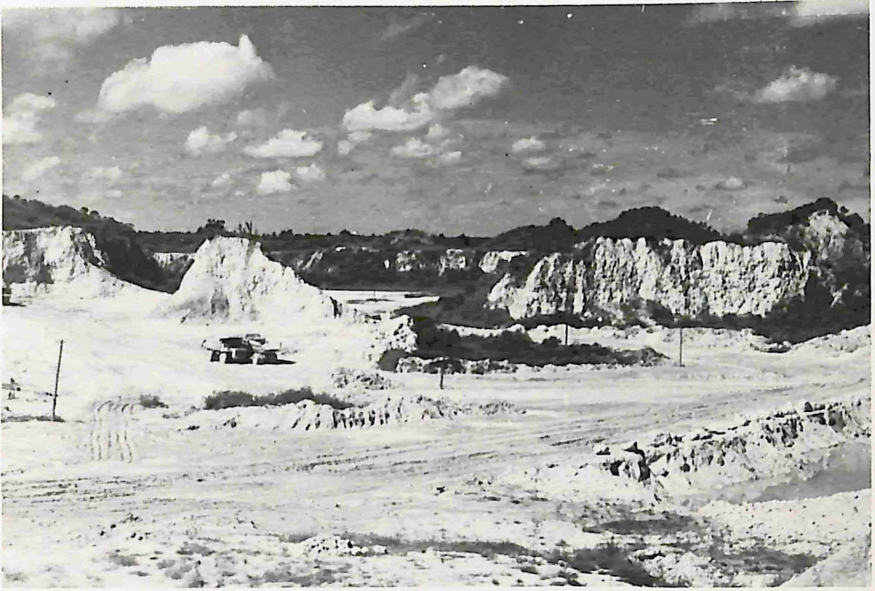


Figure 15. Camp Concrete and Rock Company Quarry, showing transportation of rock to plant crusher.

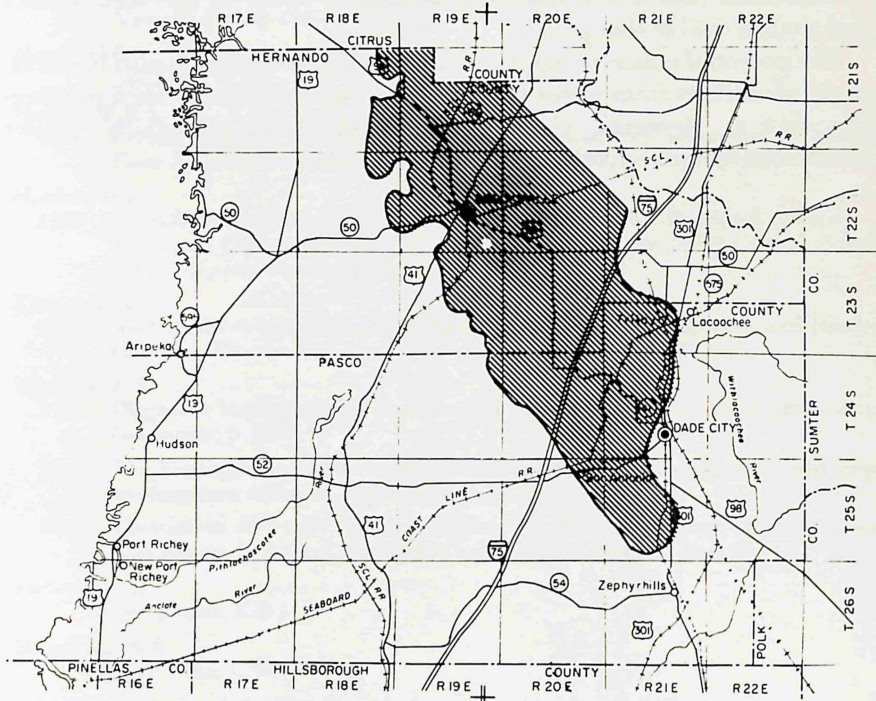


Figure 16. Hatched area indicates distribution of potential limestone aggregate in Hernando and Pasco counties.

crete aggregate is based on the study of samples from existing quarries and well cuttings, and therefore the delineation is generalized.

As previously mentioned, the karst surface developed on top of the Suwannee Limestone makes the thickness of the formation variable. A comparison between the contour map of the top of the Suwannee Limestone and the topographic maps of the area indicates that the subsurface highs and lows of the rock surface seem to conform to the surface topographic highs (hills) and lows (valleys). This point is particularly well illustrated by the geographic position of the quarries near Brooksville which not only are located on the subsurface limestone highs but also on topographic highs (hills). It is also interesting to note that in most cases the mining at the quarries begins along the slopes of the surface highs (hills) and the overburden is removed as the mining operation cuts into the hills.

The writers suggest that in prospecting for concrete aggregate the sites for drilling should be chosen by combining the use of the contour map of the top of the Suwannee Limestone with topographic maps of the area. To penetrate as little overburden as possible before reaching the top of the limestone it will be necessary to superimpose the contour map of the top of the Suwannee Limestone on the topographic map in order to determine where the limestone surface is equal to the land surface and to then drill at that point.

The potential concrete aggregate area in Pasco County is also based on study of cuttings from water wells but it is not as desirable for a prospective area as Hernando County because there are potentially greater amounts of material overlying the limestone.

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PART II
BULLETIN NO. 54

PETROGRAPHY OF THE SUWANNEE LIMESTONE

By
Anthony F. Randazzo

Tallahassee, Florida
1972

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PETROGRAPHY OF THE SUWANNEE LIMESTONE

By
Anthony F. Rondazzo

INTRODUCTION

The true character of the Suwannee Limestone can be ascertained best by thin section studies. The petrography of this formation has never been determined. In order to describe and recognize the nature of the limestones present and investigate the relationships observed or suspected in megascopic observations, a typical exposure was selected for sampling. Specimens were collected vertically from the south wall of the Camp Quarry located near Brooksville in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 8, T22S, R18E. These samples were taken at approximately one-foot intervals wherever possible. Thin sections were prepared for 27 of these samples. The petrographic analysis which resulted in the establishment of microfacies took into consideration mineralogy, original texture, clastic and chemical constituents, diagenetic effects, and paleontology. Petrographic nomenclature follows that of Folk (1962). Approximately 300 points were counted for each slide resulting in an accuracy of ± 4 percent in the 10-80 percent range according to van der Plas and Tobi (1965). Results of point counting are presented in Table 1.

A preliminary set of four microfacies was recognized in the vertical section. This set demonstrates the petrographic nature of the formation in this area but can be applied to megascopically similar rocks in the region. The calcilutite, described megascopically in the field, contains the sandy pelmicrite and sandy intrasparite facies and the calcarenite includes the biopelsparite and biosparite microfacies. Future petrographic studies in nearby areas, as well as in the type section in Suwannee County, will better define the Suwannee limestone and substantiate megascopic observations. The vertical distribution of these facies is shown in figure 1. The biopelsparite and biosparite facies are confined to the lower $\frac{1}{4}$ of the section, while the sandy pelmicrite and intrasparite are found in the upper $\frac{1}{4}$.

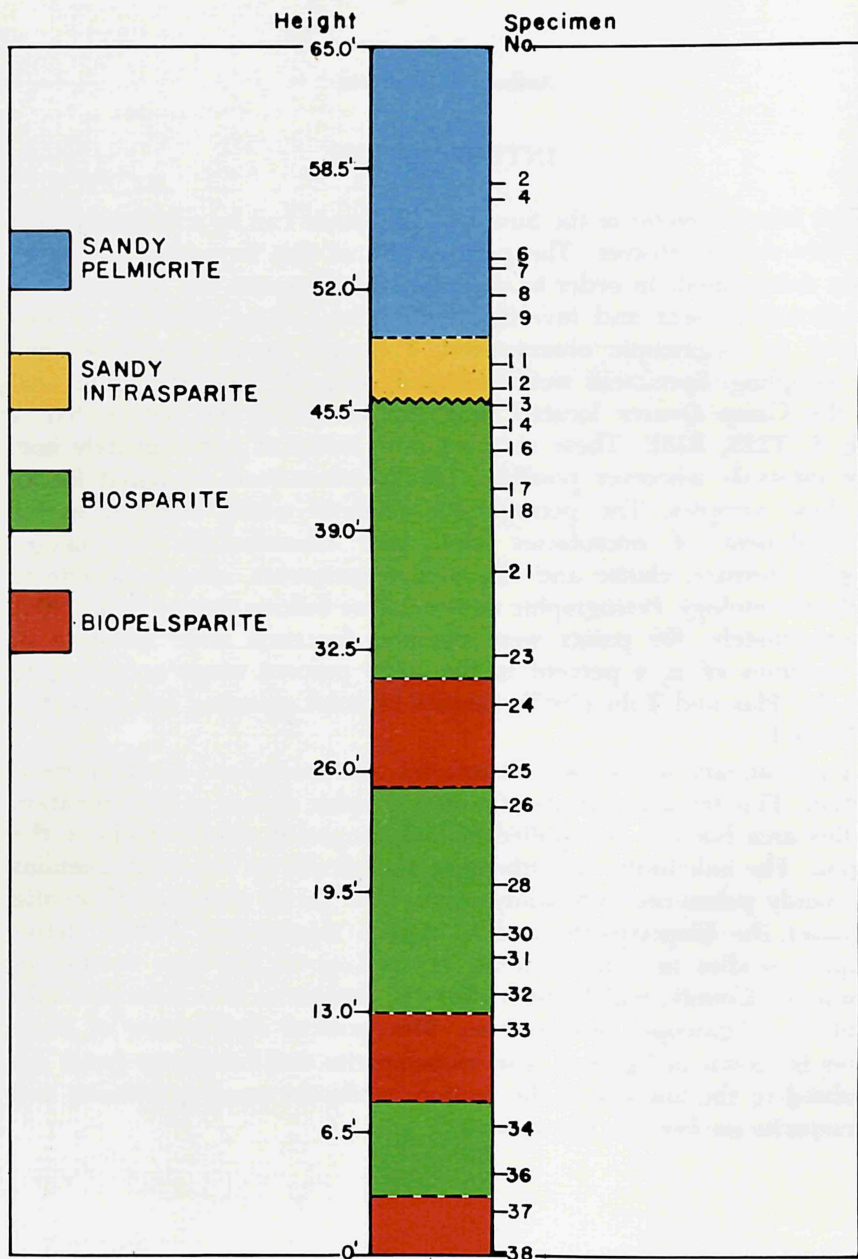


Figure 1. Verticle section at Camp Concrete and Rock Company Quarry, Her-
nando County, Florida.

Table 1. Results of point counting. Percentages have been rounded off to the nearest whole percent.

Specimen No.	Fossils	Intraclasts Composite Grains	Pellets	Detrital Grains	Micrite	Micro-Pseudospar	Sparite	Chert	Opaque Grains	Total Percent
2	1	18	7	9	39	13	13	1	—	101
4	—	14	3	11	36	12	23	—	1	100
6	—	8	2	13	46	12	17	2	1	101
7	—	10	3	15	47	9	13	1	1	99
8	—	15	1	11	43	15	15	—	—	100
9	—	8	—	14	29	23	24	—	1	99
11	—	33	1	8	11	8	37	1	1	100
12	—	50	1	6	4	3	32	1	2	99
13	18	4	1	1	4	2	65	—	4	99
14	27	9	2	3	12	1	46	—	—	100
16	28	5	4	2	6	7	36	9	3	100
17	31	3	5	1	9	8	41	1	1	100
18	32	3	3	2	7	12	38	2	1	100
21	21	7	3	1	14	9	40	3	1	99
23	41	7	6	—	5	8	32	1	1	101
24	23	7	9	—	6	11	42	2	1	101
25	30	5	9	—	8	8	40	—	—	100
26	38	5	5	—	10	9	31	—	3	101
28	34	5	7	—	7	7	37	2	1	100
30	38	12	3	1	7	3	34	—	1	99
31	40	2	8	—	12	7	28	1	1	99
32	39	4	5	—	8	8	35	—	—	99
33	23	5	10	—	10	6	43	2	2	101
34	38	3	7	—	8	3	38	2	2	101
36	21	3	3	—	10	10	49	3	2	101
37	13	6	9	1	25	8	35	3	2	102
38	17	5	13	—	13	14	34	2	3	101

PETROGRAPHY

BIOPELSPARITE

Five thin sections are representative of this microfacies. The specimens at the bottom of the section (figure 1) contain more micrite and are more poorly sorted than those found interbedded with biosparite in the central part of the column. Fossils represent the principal allochemical constituent and include intact and fragmented foraminifers, algae, bryozoans, pelecypods, gastropods, echinoderms, and ostracods. The pellets are probably fecal in origin, ovoid, moderately well sorted and vary from 0.2 mm. to 0.03 mm. Modest percentages of intraclasts are present. These allochems range in size from 1.15 mm. to 0.2 mm. and include composite grains. Some recrystallization of micrite to microspar and pseudospar has occurred but sparry calcite is the most abundant orthochemical constituent (figure 2).

BIOSPARITE

Biosparite is the most abundant microfacies and is represented by fourteen of the thin sections (figure 3). It occurs in the central part of the vertical section (fig. 1) and interbedded in places with biopelsparite. Sparry calcite is very abundant, comprising some 30-50 percent of many of the samples. Micrite content usually ranges from 10-15 percent. Fossils are the chief allochemical component, in some cases, making up 40 percent of the rock. Whole and fragmented foraminifers, algae, bryozoans, pelecypods, gastropods, echinoderms, and ostracods are all present. Other allochemical constituents, such as intraclasts and pellets, are in minor abundances.

SANDY INTRASPARITE

Overlying the uppermost biosparite is the sandy intrasparite facies from which two thin sections were studied (fig. 1, 4). This facies is characterized by having a high percentage of intraclasts and composite grains made up of subangular to rounded sand and pebble-sized particles of micrite most often containing quartz grains, pellets, and occasional fossils. This facies differs considerably from the previously mentioned two microfacies in the almost complete absence of fossils and in the greater abundance of detrital sand-sized quartz grains. Calcite spar is the principal orthochemical component but

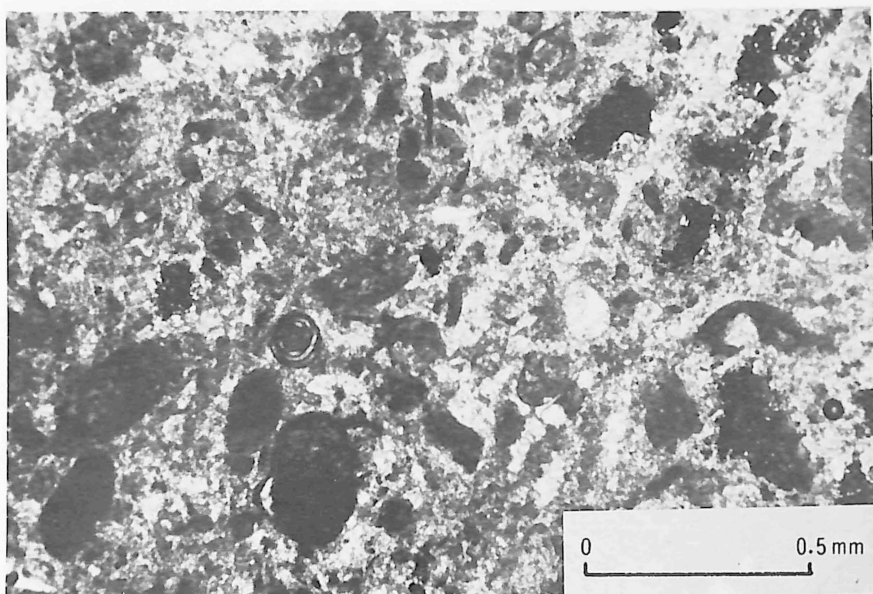


Figure 2. Photomicrograph of sample No. 25 — Biopelsparite; foraminifers, assorted skeletal fragments and pellets in sparry calcite cement; X-Nichols.

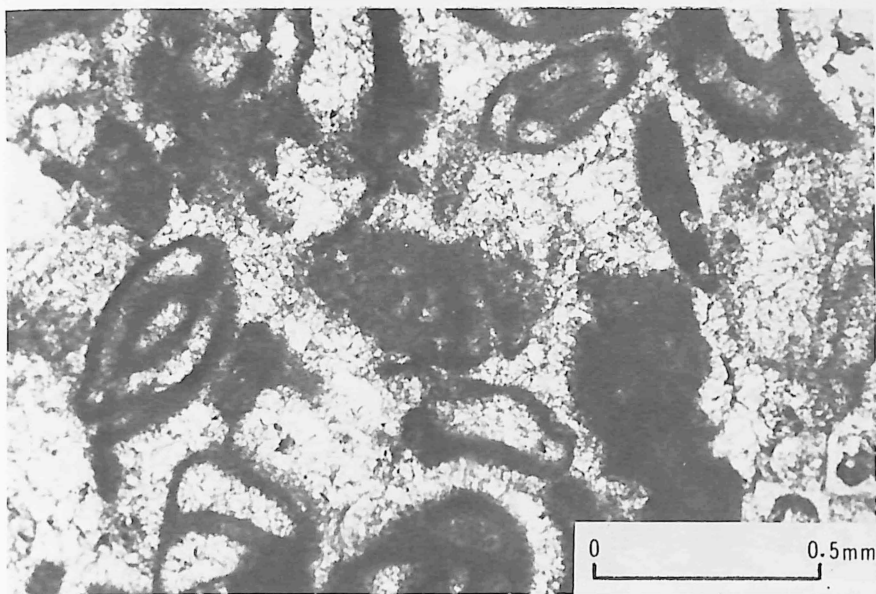


Figure 3. Photomicrograph of sample No. 14 — Biosparite; micritized foraminifers in a mosaic of sparry calcite cement; X-Nichols.

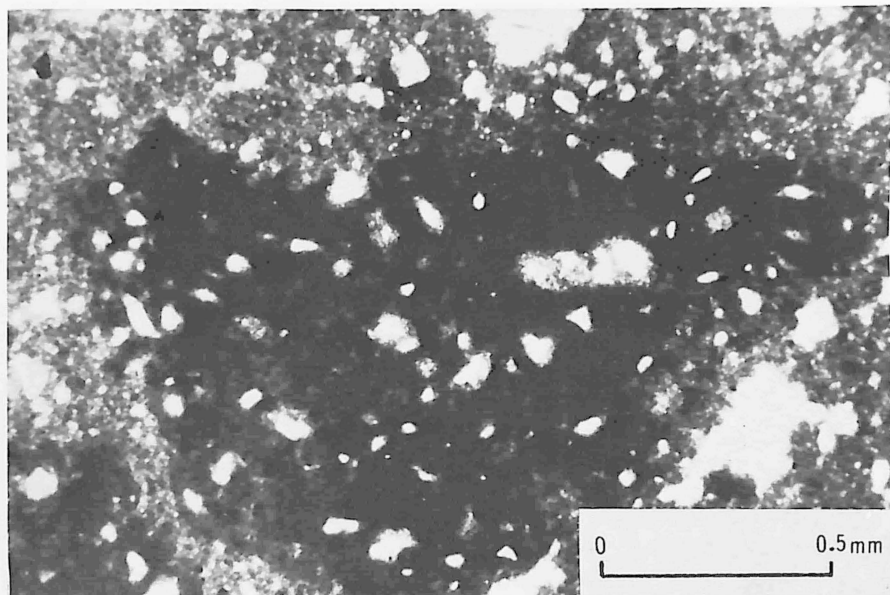


Figure 4. Photomicrograph of sample No. 11 — Sandy Intrasparite; large composite grains associated with detrital quartz grains and some micrite in sparry calcite cement; the large composite grain here contains quartz grains, pellets, intraclasts and micrite; plain polarized light.

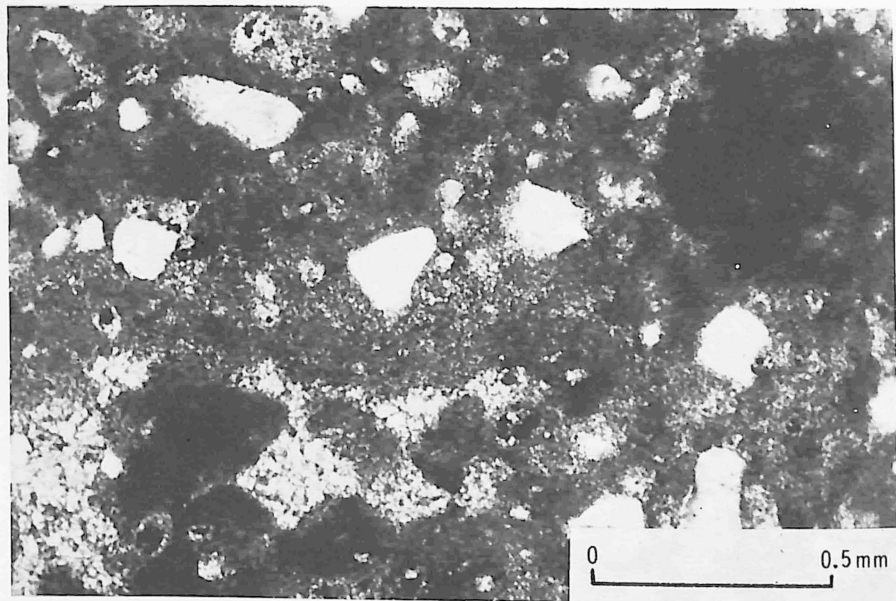


Figure 5. Photomicrograph of sample No. 7 — Sandy Pelmicrite; pellets, intraclasts, and detrital quartz grains in micrite; several patches of pseudospar are present; X-Nicols.

specimen No. 11 did show an appreciable amount of recrystallization of micrite to microspar and pseudospar.

SANDY PELMICRITE

The top 14 feet in the quarry section contains the sandy pelmicrite facies (fig. 1, 5). Six thin sections were studied from this microfacies. Pellets, intraclasts, and composite grains are the principal allochemical constituents. Detrital quartz grains are also present. Micrite and recrystallized microspar are abundant, while spar and pseudospar are minor constituents of this facies. The almost complete lack of fossils, and the increase of detrital sand-sized quartz grains found in the sandy intrasparite facies, is also true for this facies.

POROSITY

The visible porosity of these rocks, measured in thin section, varies among facies. The sandy pelmicrite facies has the lowest porosity ranging from 1-8 percent. The other facies have somewhat higher porosities, ranging from 1-40 percent, with values of 5-20 percent most representative. The porosity of the biosparite is slightly higher than the others.

Porosity is most commonly of three types, vug, intergranular (including both interparticle and intercrystal), and moldic. The intergranular and moldic types are fabric selective (Choquette and Pray, 1970) but the vug type is not. Most of the porosity is secondary involving postdepositional solution of aragonite mollusk shells and the enlargement of the other fabric selective pores. Sparry calcite cement, where abundant, has destroyed most of the primary porosity in those specimens. The low visible porosity of the sandy pelmicrite facies is attributed to its higher micrite content. This facies probably possessed a higher intergranular porosity than was observed but the pore spaces are too fine to be seen. Most of the spaces encountered in the various facies would be classified according to Choquette and Pray's (1970) classification as micro (less than 1/16 mm. average diameter) and small mesopores (1/16 - 1/2 mm. average diameter).

PALEOENVIRONMENTAL INTERPRETATIONS

The data presented in Table 1 have been plotted in figures 6 and 7 in order to detect significant trends. Figure 6 is a plot of the micrite

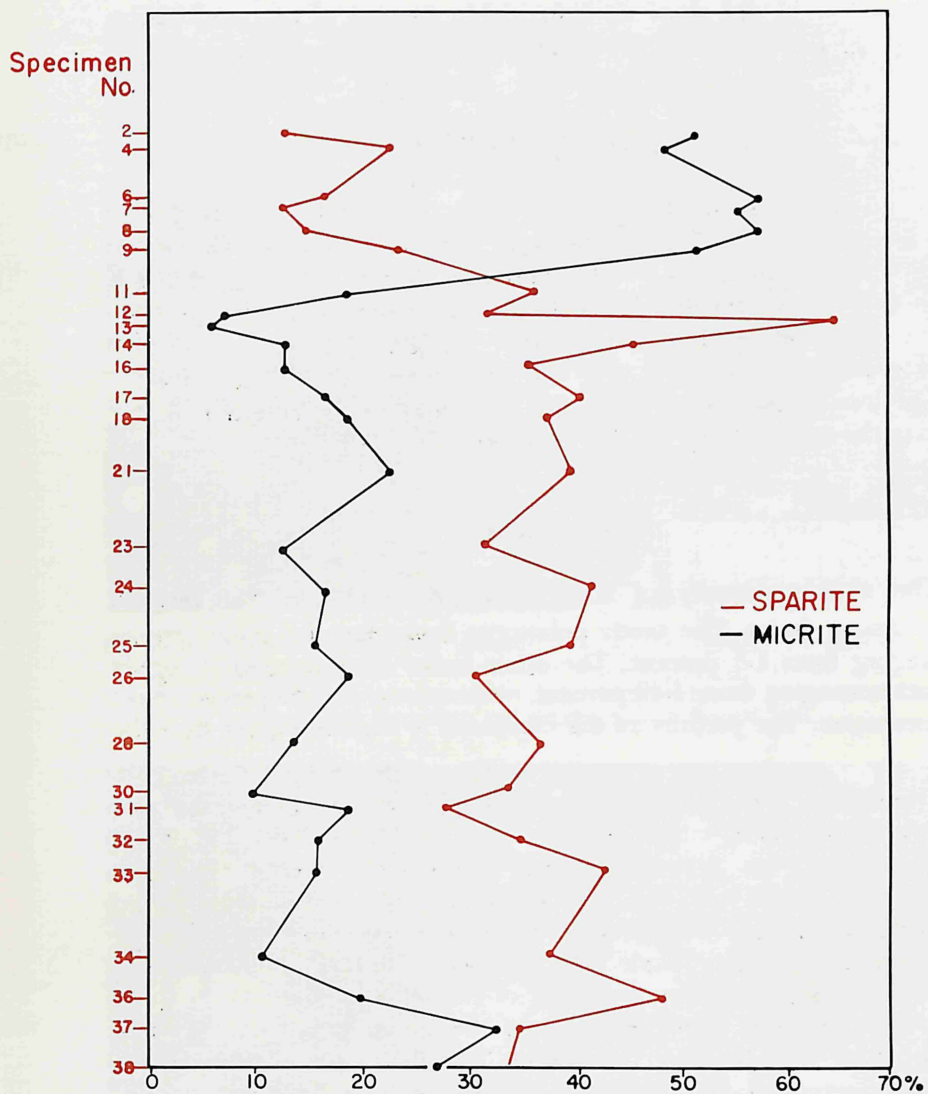


Figure 6. Variation of micrite and sparite percentages among the samples of the vertical section.

and sparite contents. The micrite-sparite content is a general indicator of energy levels at the depositional site. In low energy environments, such as a protected lagoon, lime mud may be allowed to accumulate and sparry calcite cement would not be an important part of the lithification process. In a more energetic environment, lime mud may be winnowed leaving pore spaces among the allochemical constituents

which may later be filled with diagenetic sparry calcite cement. Because of the higher degree of error from the actual variation of thin section components counted than from variations from slide to slide, percentage changes of ten percent or less between samples are not significant. More significant are the greater percentage differences of constituents from sample to sample. The micrite-sparite trends observed in figure 6 show a significant increase in sparite content from sample no. 9 to no. 11 (approximately 16 feet below the top of the quarry). This increase in sparite content plateaus for the samples in the central and lower parts of the section. The micrite content also shows some rather dramatic changes at the same sample position (no. 9 and no. 11). The micrite content remains low except for a noticeable increase at the bottom of the section (samples no. 37 and no. 38). This is accompanied by an increase in sparite for these two samples. The changes in trend reflect the microfacies established above.

In order to apply the energy concept to these variations in the recognition of transgressive and regressive phases of the sea, assumptions must be made with regard to geomorphic position of this area as a depositional site during Oligocene time. Lime mud indicates a low energy environment which can exist in a number of different environments including shallow water lagoonal, supratidal, intertidal and shallow and deep subtidal. When additional vertical sections are studied petrographically, the relative geomorphic positions of the sections should be ascertained. Because such data are not available at this time, several assumptions will be investigated in order to gain some insight as to the nature of the environment of deposition. One assumption will start with samples No. 37 and No. 38 representing a near shore — low energy environment where there has been sufficient water agitation to remove some lime mud with the infilling of spar at a later time. A transgression of the sea would be represented by the decrease in micrite content in specimens No. 36 through 13. The environment may have now changed to a shallow subtidal area where wave base produced noticeable winnowing of micrite. Specimens No. 12 and No. 11 show the beginning of another change because of the rapid decrease in spar accompanied by an increase in micrite. This could be interpreted as a regression of the sea and a return to quiet water conditions where lime mud could accumulate and specimens No. 9 through No. 2 formed.

Another interpretative alternative would start with specimens No. 37 and No. 38 representing a deep water subtidal environment where water agitation of the bottom was variable, allowing some lime mud to accumulate. Specimens No. 36 through No. 13 would represent a regression of the sea allowing wave base to become an important factor in the winnowing of micrite. A general high energy environment, probably shallow

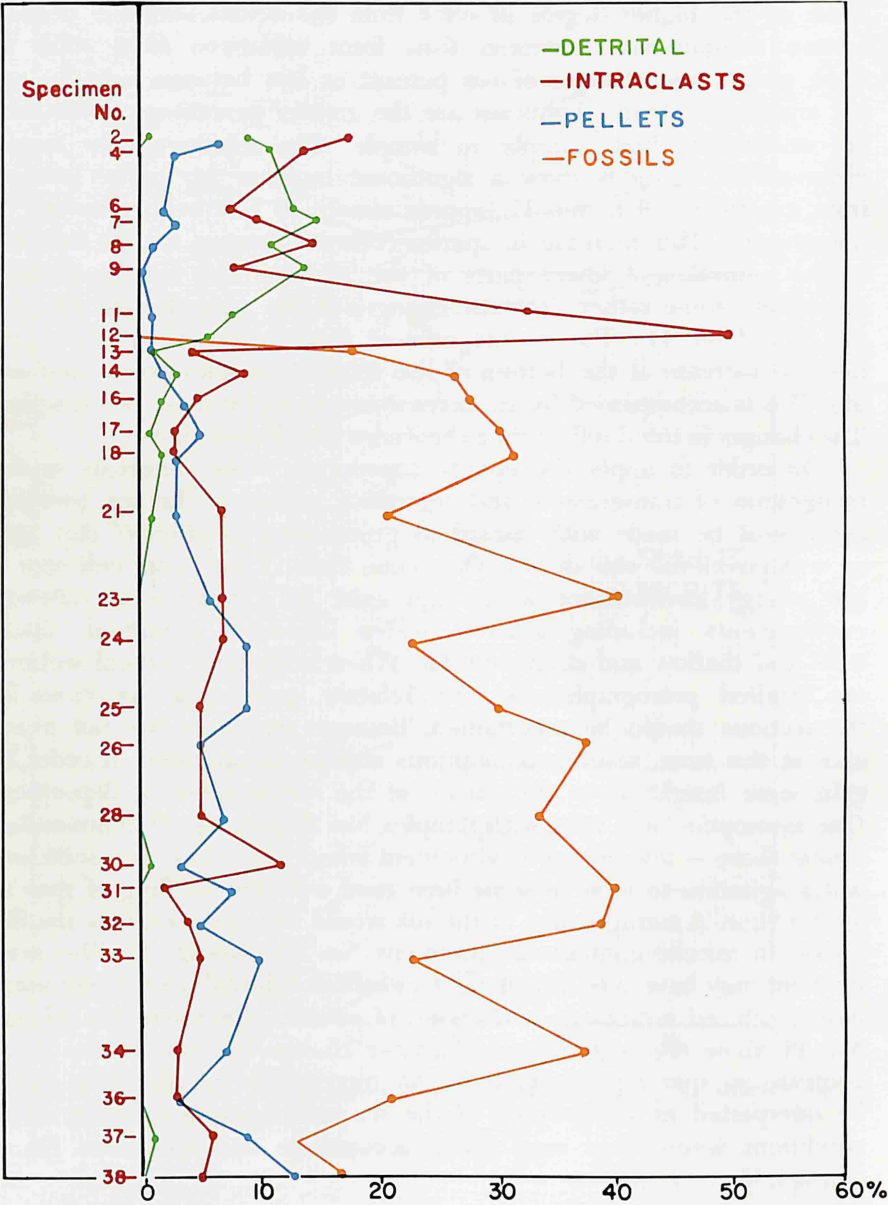


Figure 7. Variation of fossil, pellet, intraclast, and detrital quartz percentages among the samples of the vertical section.

subtidal and perhaps intertidal, would result. Specimens No. 12 and No. 11 would indicate another sea transgression with deeper waters returning. Accompanying this return of the sea would be lower energy conditions

allowing more lime mud to accumulate. Specimens No. 9 through No. 2 would represent this depositional phase.

Still another approach to the resolvment of the question of which assumption is more likely to have fit actual conditions, would be analysis of allochemical components of the samples. Percentages of fossils, intraclasts, pellets, and extrabasinal detrital quartz grains were plotted in figure 7. Allochems can aid in the deciphering of energy conditions as well as geomorphic conditions of the depositional environment. The occurrence of detrital quartz, most probably derived from a positive area to the northeast, (initial effects of the Ocala Uplift?), is useful as a guide for determining nearness to shore. The variations plotted in figure 7 best meet the conditions of the first interpretative assumption made for figure 6. Assuming a near shore low energy environment existed when specimens No. 37 and No. 38 formed, the lack of detrital material could be explained by the negativeness of the land mass. A transgression of the sea would have placed the land farther away resulting in the lack of extrabasinal material. If this transgression were accompanied by a higher energy level, as indicated by the lower micrite-sparite ratio, the open sea conditions may have been more conducive for marine life to flourish. This would account for the fossil percentages of specimens No. 36 through No. 13. The intraclast and pellet percentages for these samples are not indicative of energy level or water depth changes.

The regression of the sea and the return to shallow water conditions could account for the sudden increase in interclast and detrital quartz content. Specimens No. 12 and No. 11 may represent a time when water agitation at wave base could have caused substantial tearing up of the sea floor, creating intraclasts and the new environment may have been detrimental to marine life as evidence by the lack of fossils. A nearness to shore would account for the detrital quartz. Continual regression could then have resulted in the return to lower energy shallow water conditions under which specimens No. 9 through No. 2 formed.

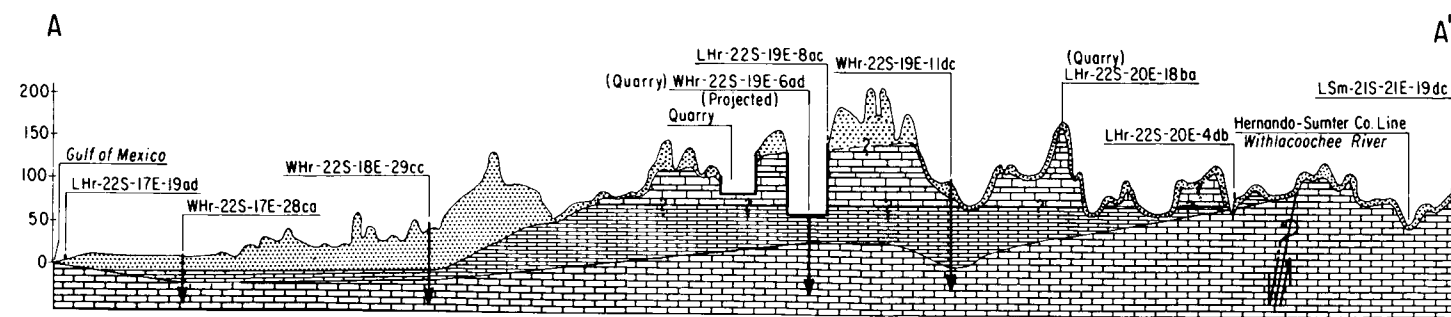
An additional possibility exists regarding this last hypothesis. The rather striking differences in allochemical constituents being accumulated at the position of specimen No. 13 could be interpreted as a disconformity of uncertain magnitude. Specimens No. 12 and No. 11 could represent a basal conglomerate signifying another transgressive phase of the sea. The lack of fossils could be attributed to a time lag in the ability of marine organisms to reestablish themselves to this newly created marine environment. Field observations strongly suggest a difference in lithologic character and environmental change to substantiate the credibility of this petrographic interpretation. Specimens No. 12, 11, 9, 8, 7, 6, 4 and 2 may not be part of the Suwannee Limestone or even Oligocene in age. The Suwannee Limestone may be a time transgressive stratigraphic formation.

To briefly summarize, the paleoenvironmental interpretation best fitting the petrographic observations is as follows:

- 1) A near shore low energy environment existed when specimens No. 37 and No. 38 formed.
- 2) A transgression of the sea accompanied by higher energy conditions produced a shallow subtidal environment where specimens No. 36, 34, 33, 31, 30, 28, 26, 25, 24, 23, 21, 18, 17, 16, 14, and 13 were deposited.
- 3) A regression of the sea removed a portion of the rock record and created a disconformity.
- 4) The sea returned to the area with the deposition of a basal carbonate conglomerate (specimens No. 12 and No. 11).
- 5) Low energy shallow water (probably intertidal) conditions prevailed with the formation of specimens No. 9, 8, 7, 6, 4 and 2.

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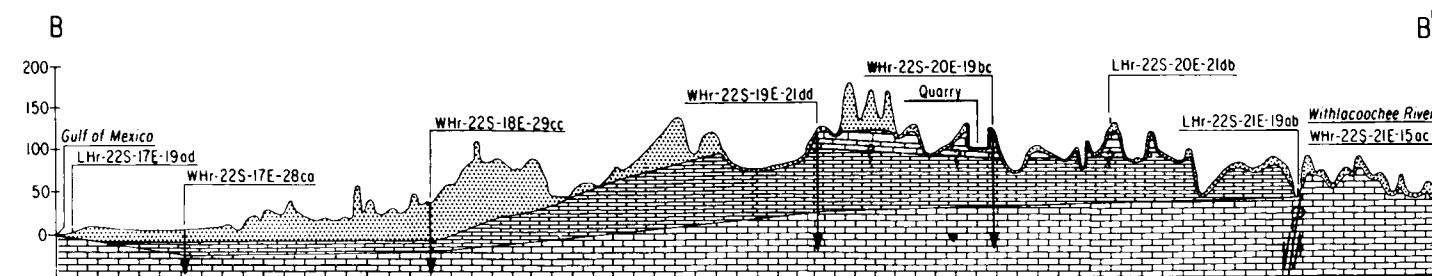
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EXPLANATION

- Post-Suwannee
- Crystalline Limestone (Suwannee Limestone)
- Partially Recrystallized Ls. (Suwannee Limestone)
- Crystal River Formation

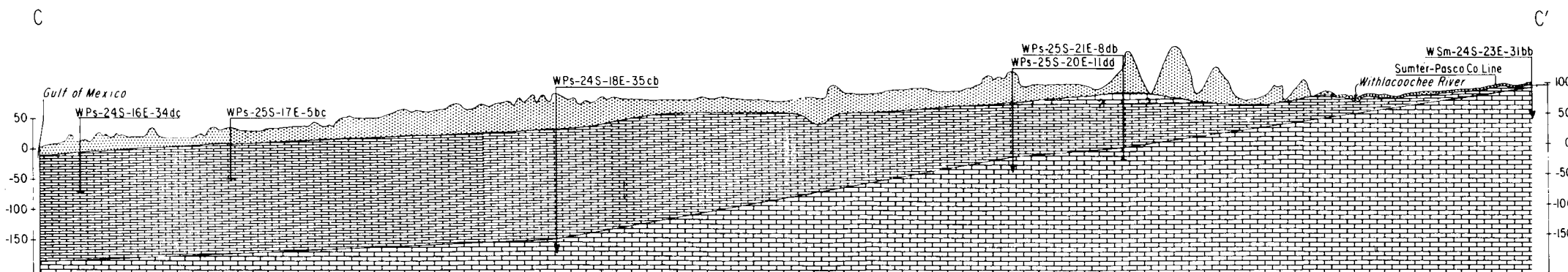
0 1 2 Miles
Approx. Scale



EXPLANATION

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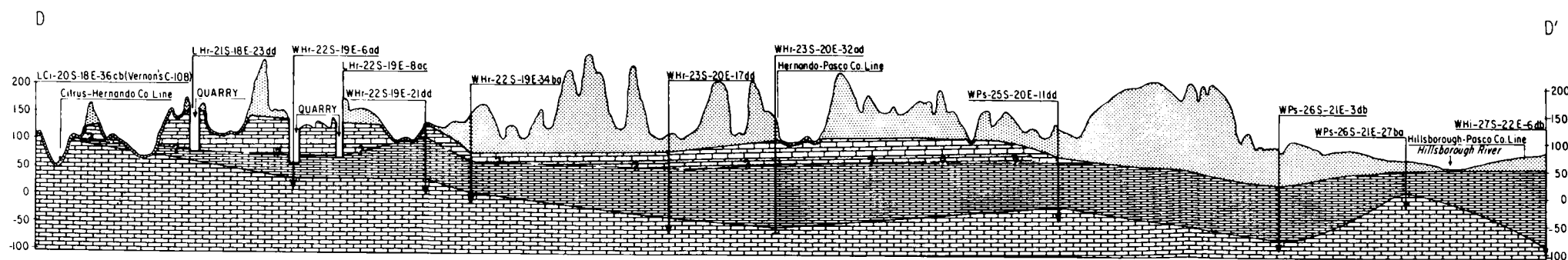
0 1 2 Miles
Approx. Scale



EXPLANATION

- Post Suwannee
- Crystalline Limestone (Suwannee)
- Partially Recrystallized Ls. (Suwannee)
- Crystal River Formation

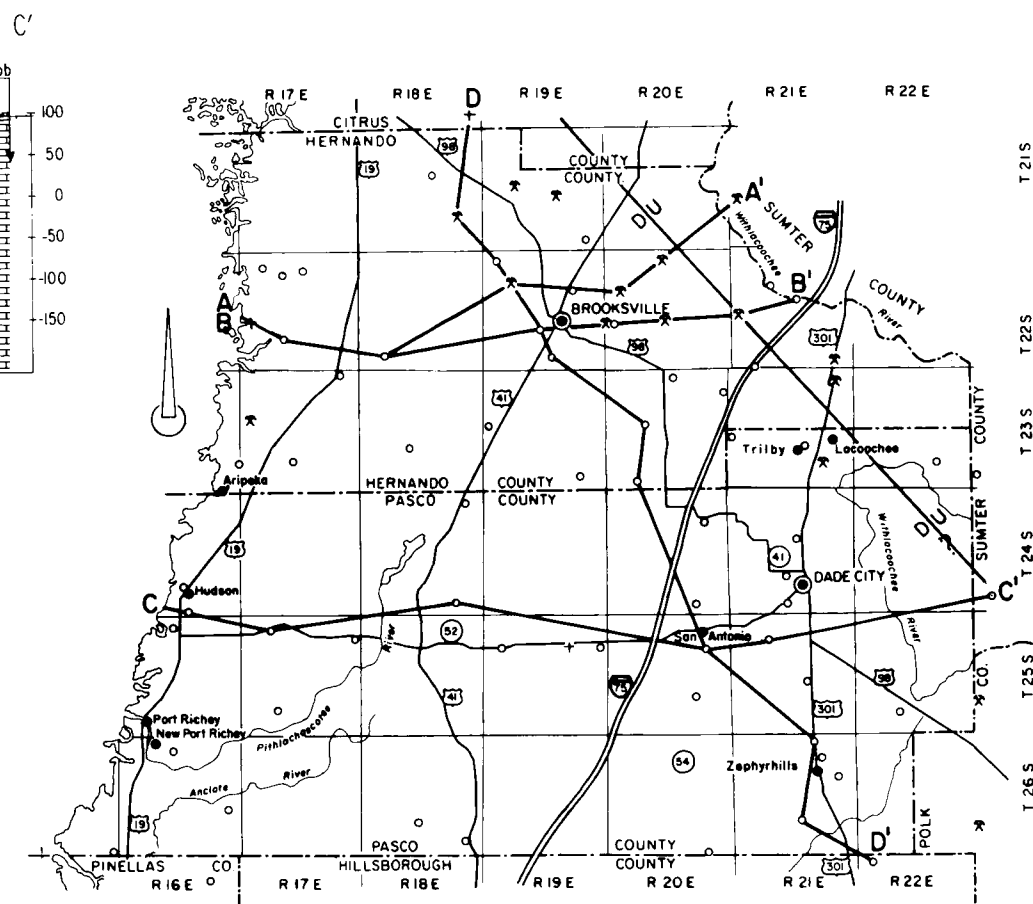
0 1 2 Miles
Approx. Scale



EXPLANATION

- Post-Suwannee
- Crystalline Limestone (Suwannee Limestone)
- Partially Recrystallized Ls. (Suwannee Limestone)
- Crystal River Formation

0 1 2 Miles
Approx. Scale



EXPLANATION

- Well location
- Quarry
- Outcrop

A—A' Line of cross section

0 2 4 6 Miles
Approx. Scale

LOCATION
Hernando-Pasco Counties

Figure 7. Stratigraphic Cross Sections along lines A-A', B-B', C-C' and D-D'.

