PETROGRAPHIC EVALUATION OF SELECTED SAMPLES FROM THE AVON PARK FORMATION, FROM THE OKF-105 WELL, OKEECHOBEE COUNTY, FLORIDA

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Performed for

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Performed by:

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October 31st, 2009

South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

Attention: Emily Richardson
Subject: Petrographic Study on the OKF-105 Well, Okeechobee County, Florida.

Ms Richardson:

This report presents a summary of the results of thin section petrography (TS) on fifteen (15) samples and X-ray diffraction (XRD) on fifteen (15) samples from the OKF-105 well, Okeechobee County, Florida. These samples were sent for analysis to determine the overall mineralogy, the nature of pore system and pore-filling authigenic minerals. In addition, the timing and nature of the dolomitization and probable depositional environments were determined. A list of samples analyzed and a summary of sample data is presented in Table 1 and the XRD data is presented in Table 2. TS photomicrographs are provided in plates 1A-C through 15A-C.

If you have any questions, or wish further explanation about any aspect of these samples, please feel free to contact me.

Sincerely,

Joseph Beckner
Staff Geologist/Project Manager
Core Laboratories Petroleum Services
713-328-2561 joseph.beckner@corelab.com

PETROGRAPHY

Introduction

A total of fifteen (15) samples were analyzed from the OKF-105 Well, four dolostones (Plates 1, 2, 3, & 4) from the Upper Zone, and eleven limestones, dolomitic limestones and dolostones from the Lower Zone (Plates 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15). Carbonate pore type classification was followed from Choquette and Pray (1970), as given in Figure 3.

Lower Zone Limestones/Dolomitic Limestones (2100.90, 2101.90, 2103.10, 2104.10, 2105.10, 2106.4, 2107.6, 2110.20, 2111.85, 2113.10 and 2114.7 feet)

Textures

These samples range from bioclast dolopackstone/dolowackestones (base) to bioclast peloid grainstones (top). Primary textures in the dolostones are well preserved. The distribution of matrix in these samples is irregular, suggesting that they were bioturbated.

Grain Types

Bioclasts range from moderate (deeper, muddier samples) to abundant (shallower, cleaner samples). Identifiable types include echinoderm fragments, gastropods, benthic foraminifera (e.g. textularids, rotalids and miliolids, planktic foraminifera, dasyclad algal grains, red algae, and mollusks. Other allochemical grains include intraclasts (mudstone/wackestone clasts) and peloids

Matrix

Micrite matrix varies from absent (Plates 5 and 6) to common (Plates 7, 8 & 9), to abundant (Plates 11, 12, 13, 14, 15). In some of the samples, the matrix was extensively (preferentially dolomitized).

Authigenic Mineralogy

In most samples, two types of early calcite cement are observed. The first type consists of clear, very finely to finely crystalline, pore-lining calcite cement; the second consists of syntaxial calcite overgrowths which typically nucleate around echinoderm fragments. Early pyrite cements likely formed around the same time as the early calcite cements, often precipitating inside bioclasts.

Paragenetic Sequence:

- Grain micritization and leaching of aragonitic skeletal grains, and neomorphism of micrite to microspar.
- Precipitation of isopachous calcite cement and coarse spar in grainstone and syntaxial calcite overgrowths on echinoderm fragments. Most of these samples were well cemented before dolomitization.
- Dissolution of bioclasts, forming molds and vugs.
- Dolomitization.

The overall dolomite coarseness and preservation of original limestone fabrics (indicating slow crystallization), plus evidence of syntaxial rims, suggest that these dolomites were formed by meteoric water-sea water mixing in the subsurface.

Pore Types
Macropores are common the shallowest limestones (2100.9, 2101.9, 2103.1 and 2104.1 feet); primary between particle pores are well preserved due to the lack of significant matrix or calcite cementation. Primary within particle pores, moldic pores, vuggy pores and secondary within particle pores. The deeper dolomitic limestones and dolostones contain common to abundant matrix and fewer macropores. In these samples, moldic and vuggy pores are as common, or more common than primary between particle pores

In general, dolomitization has improved the overall storage/recovery potential for these samples.

Environment of Deposition
The fairly wide variety of allochemical types suggest that these sediments were deposited on a normal marine, shallow carbonate shelf. The deepest samples are packstone/wackestones to mud-rich packstones; these samples also contain planktonic foraminifera. These sediments were deposited in deeper water, below tidal and wave influence.

As we move to the shallower samples, the ratio of mud to grains decreases and the overall grain size increases. This indicates a shift from a low energy, subtidal environment to mixed energy intertidal environment.

The shallowest samples are mud lean packstone to grainstones. The lack of mud indicates constant reworking by currents. These sediments were deposited in a shallower portion of the intertidal zone, but there is no evidence of subareal exposure.

Client information indicates that anhydrite is present in the core. The anhydrite was likely deposited in a peritidal environment with high rates of evaporation. This would be stratigraphically above the shallowest sample (2100.9 feet) from this zone.

Upper Zone Dolomites (1700.0, 1701.9, 1704.2 and 1706.0 feet)
Textures
Dolomite replacement produced a variety of fabrics, including those with some of the fabric retained (Plates 1, 2 and 4) and those where the dolomite forms a texture of interlocking crystals with little evidence of the original rock fabric (Plate 3).

Grain Types
Bioclast ghosts are difficult to recognize, but include benthic foraminifera (e.g. textularids, rotalids), calcareous algae, gastropods and mollusk fragment. Other recognizable allochemical grains include peloids and intraclasts.

Authigenic Mineralogy
Dolomite is the primary mineral phase in these samples; some authigenic pyrite is noted. It can be assumed that before dolomitization, these samples experienced the same diagenetic effects as the previously deposited limestones:

- Grain micritization and leaching of aragonitic skeletal grains, and neomorphism of micrite to microspar.
- Precipitation of isopachous calcite cement and coarse spar in grainstone and syntaxial calcite overgrowths on echinoderm fragments. Unlike the sample from he

lower zone, these samples appear to have been well cemented before dolomitization (much fewer primary pores were preserved.

- Dissolution of bioclasts, forming molds and vugs.
- Dolomitization (but not necessarily the same event as before).
- Sample fracturing and the formation of compaction seams

The dolomite crystals are relatively coarse and preservation of original limestone fabrics (indicating slow crystallization) is good, Most of what were interparticle pores were cemented with calcite (some evidence of syntaxial rims), suggesting that these dolomites were formed by meteoric water-sea water mixing in the subsurface. The dolomitization process improved the storage/recovery potential for these samples.

Pore Types

Overall, macropores are common in these dolomites. Moldic and vuggy pores are the most common type in the samples where there is enough preserved texture to determine pore types. In one sample, intercrystal pores are more common than other types.

Environment of Deposition

The variety of preserved allochemical grains suggest that these sediments were deposited on an open, shallow carbonate shelf. The grainstone texture indicates that these sediments were deposited in a high energy environment, perhaps a carbonate shoal.

ANALYTICAL PROCEDURES

Thin Section Petrography

Thin sections were prepared by first impregnating the samples with epoxy to augment cohesion and to prevent loss of material during grinding. Blue dye was added to the epoxy to highlight the pore spaces. Each thinly sliced sample was mounted on a frosted glass slide and then cut and ground in water to an approximate thickness of 30 microns. The thin sections were stained with Alizarin Red-S to differentiate calcite (stains red) from dolomite and potassium ferricyanide (stains blue or purple) to distinguish ferroan varieties. The thin sections were analyzed using standard petrographic techniques.

X-ray Diffraction Analysis

Sample Preparation

Samples submitted for whole-rock and clay-fraction XRD mineral analyses are first cleaned of obvious drilling contaminants and then disaggregated in a mortar and pestle. Approximately five grams of each sample are transferred to isopropyl alcohol and pulverized using a McCrone micronizing mill. The resultant powders are dried, disaggregated, and packed into aluminum sample holders to produce random whole-rock mounts. A separate split of each sample is dispersed in a dilute sodium phosphate solution using a sonic probe. The suspensions are then centrifugally size-fractionated to isolate clay-size (<4 micron ESD) materials for a separate clay-fraction mount. The suspensions are then vacuum-deposited on silver membrane filters to produce oriented clay mineral aggregates. Membrane mounts are attached to stainless steel slugs and exposed to ethylene glycol vapor for a minimum of 24 hours.

Analytical Procedures

XRD analyses of the samples are performed utilizing a Scintag or Philips automated powder diffractometer equipped with a copper source (40kV, 40mA) and a solid state or scintillation detector. The whole-rock samples are analyzed over an angular range of 2-60 degrees 2-theta at a scan rate of one degree/minute. The glycol-solvated clay-fraction mounts are analyzed over an angular range of 2–50 degrees 2-theta at a rate of 1.5 degrees/minute.

Semi-quantitative determinations of whole-rock mineral amounts are done utilizing integrated peak areas (derived from peak-decomposition / profile-fitting methods) and empirical reference intensity ratio (RIR) factors determined specifically for the diffractometer used in data collection. The total clay mineral (including mica) abundance of each sample is determined from the whole-rock XRD patterns using combined {00l} and {hkl} clay mineral reflections and suitable empirical RIR factors.

XRD patterns from glycol-solvated clay-fraction samples are analyzed using techniques similar to those described above. Determinations of mixed-layer clay ordering and expandability are done by comparing experimental diffraction data from the glycol-solvated clay mineral aggregates with simulated one dimensional diffraction profiles generated using the program NEWMOD written by R.C. Reynolds (1985).

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TABLE 1

South Florida Water Management District, OKF-105 Well

ANALYTICAL PROGRAM AND SAMPLE SUMMARY

Plate #:	Depth (ft)	Thin Section	XRD	Geologic Unit	Classification (modified Dunham, 1962)	Lithology	Depositional Environment	Deposition Rates	Pore Types	Storage / Recovery
1	1700.0	X	X	Avon Park Formation	Bioclast dolograinstone	Dolostone	Carbonate Shoals?	High	MO/VG > IC	Good
2	1701.90	X	X	Avon Park Formation	Bioclast peloid dolograinstone	Dolostone	Carbonate Shoals?	High	MO/VG > IC	Good
3	1704.20	X	X	Avon Park Formation	Bioclast dolograinstone	Dolostone	Carbonate Shoals?	High	VG > IC > MO	Good
4	1706.0	X	X	Avon Park Formation	Bioclast peloid dolograinstone	Dolostone	Carbonate Shoals?	High	IC > MO > VG	Good
5	2100.90	X	X	Avon Park Formation	Bioclast peloid grainstone	Limestone	Carbonate Shelf - Intertidal	High	PBP >> PWP > MO/VG > SWP	Good
6	2101.90	X	X	Avon Park Formation	Bioclast packstone	Limestone	Carbonate Shelf - Intertidal	Mixed	PBP >> PWP > MO/VG > SWP	Good
7	2103.10	X	X	Avon Park Formation	Bioclast packstone	Limestone	Carbonate Shelf - Intertidal	Mixed	PBP > > PWP > MO/VG > SWP	Good
8	2104.10	X	X	Avon Park Formation	Bioclast packstone	Limestone	Carbonate Shelf - Intertidal	Mixed	PBP > > PWP > MO/VG > SWP	Good
9	2105.10	X	X	Avon Park Formation	Bioclast peloid packstone	Limestone	Carbonate Shelf - Subtidal	Mixed	PBP/PWP > MO/VG > SWP	Poor
10	2106.40	X	X	Avon Park Formation	Dolomitic bioclast packstone	Limestone	Carbonate Shelf - Subtidal	Low	PBP / PWP > MO/VG > SWP	Fair
11	2107.60	X	X	Avon Park Formation	Dolomitic bioclast packstone	Limestone	Carbonate Shelf - Subtidal	Low	PBP/PWP > MO/VG > SWP	Poor
12	2110.20	X	X	Avon Park Formation	Bioclast peloid dolopackstone	Dolostone	Carbonate Shelf - Subtidal	Low	PBP/PWP > MO/VG > SWP	Fair
13	2111.85	X	X	Avon Park Formation	Dolomitic bioclast packstone/ wackstone	Limestone	Carbonate Shelf - Subtidal	Low	PWP > MO/VG, PBP > SWP	Poor
14	2113.10	X	X	Avon Park Formation	Bioclast dolopackstone/ dolowackestone	Dolostone	Carbonate Shelf - Subtidal	Low	PWP > MO/VG, PBP > SWP	Poor
15	2114.70	X	X	Avon Park Formation	Bioclast dolopackstone/ dolowackestone	Dolostone	Carbonate Shelf - Subtidal	Low	PWP > MO/VG, PBP > SWP	Poor

MO= Moldic Pores PBP = Primary between particle pores
VG= Vuggy Pores SWP = Secondary within particle pores
PWP = Primary within particle pores

TABLE 2

MINERALOGY DETERMINED BY X-RAY DIFFRACTION
South Florida Water Management District, Well: OKF-105

Sample ID	Depth (ft):	Whole Rock Mineralogy (Weight %)									Clay Abundance (Weight %)				
		Quartz	K-Feldspar	Plagioclase	Calcite	Dolomite	Siderite	Gypsum	Pyrite	Total Clay	Illite / Smectite	Illite & Mica	Kaolinite	Chlorite	% Smectite in I/S
1	1700.0	Tr	0	0	3	97	0	0	0	0	0	0	0	0	
2	1701.9	1	0	0	3	96	0	0	0	0	0	0	0	0	
3	1704.2	1	0	0	2	97	0	0	0	0	0	0	0	0	
4	1706.0	1	0	0	3	96	0	0	0	0	0	0	0	0	
5	2100.9	1	0	0	98	1	0	0	0	0	0	0	0	0	
6	2101.9	Tr	0	0	99	1	0	0	0	0	0	0	0	0	
7	2103.1	Tr	0	0	99	1	0	0	0	0	0	0	0	0	
8	2104.1	Tr	0	0	98	2	0	0	0	0	0	0	0	0	
9	2105.1	Tr	0	0	99	1	0	0	0	0	0	0	0	0	
10	2106.4	Tr	0	0	82	18	0	0	0	0	0	0	0	0	
11	2107.6	Tr	0	0	90	10	0	0	0	0	0	0	0	0	
12	2110.2	Tr	0	0	32	68	0	0	0	0	0	0	0	0	
13	2111.9	Tr	0	0	88	12	0	0	0	0	0	0	0	0	
14	2113.1	Tr	0	0	30	70	0	0	0	0	0	0	0	0	
15	2114.7	1	0	0	38	61	0	0	0	0	0	0	0	0	

PLATE 1A-1C

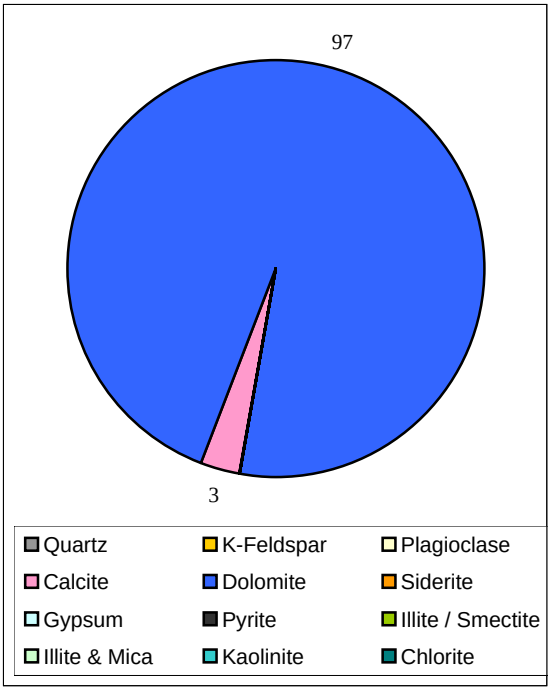
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 1700.0

The original texture of this sample has been obscured by dolomite replacement, but it was probably a bioclast grainstone. This sample contains "ghosts" of what were probably benthic foraminifera (ForB) and algae fragments (alg); most allochemical grains are not recognizable. The moldic pores (MO) were originally bioclasts or intraclasts. Vuggy pores (VG) developed where dissolution continued past grain boundaries. Many pores lack or have uncertain textural references and are classified as intercrystal pores (IC). A very irregular clay-rich seam (cla) horizontally crosses the sample. Because this sample has abundant macropores (blue), and they seem well interconnected. it has good to very good storage/recovery potential.

Mineralogy Determined by X-Ray Diffraction (Weight %)



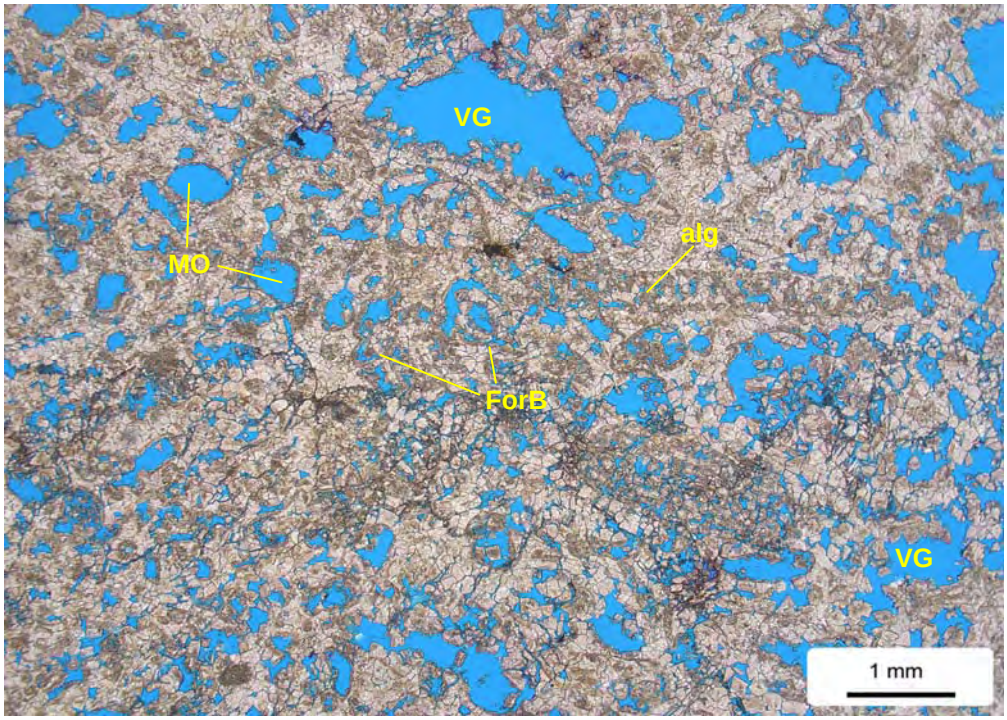
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	3	Total Clay	0
Dolomite	97		

Clay Abundance (Weight %)

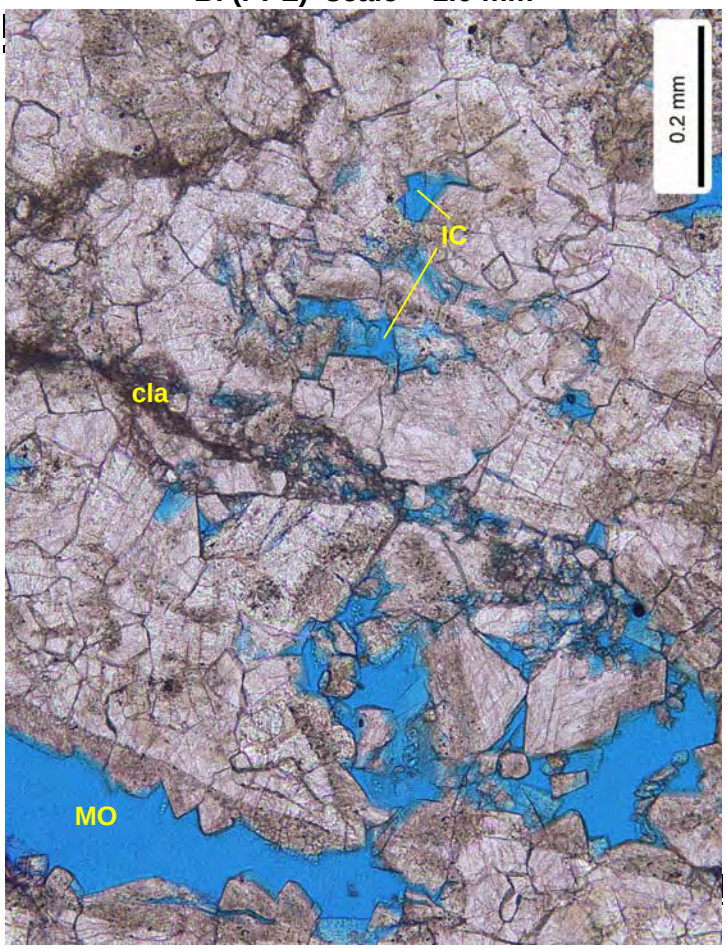
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 1A-1C

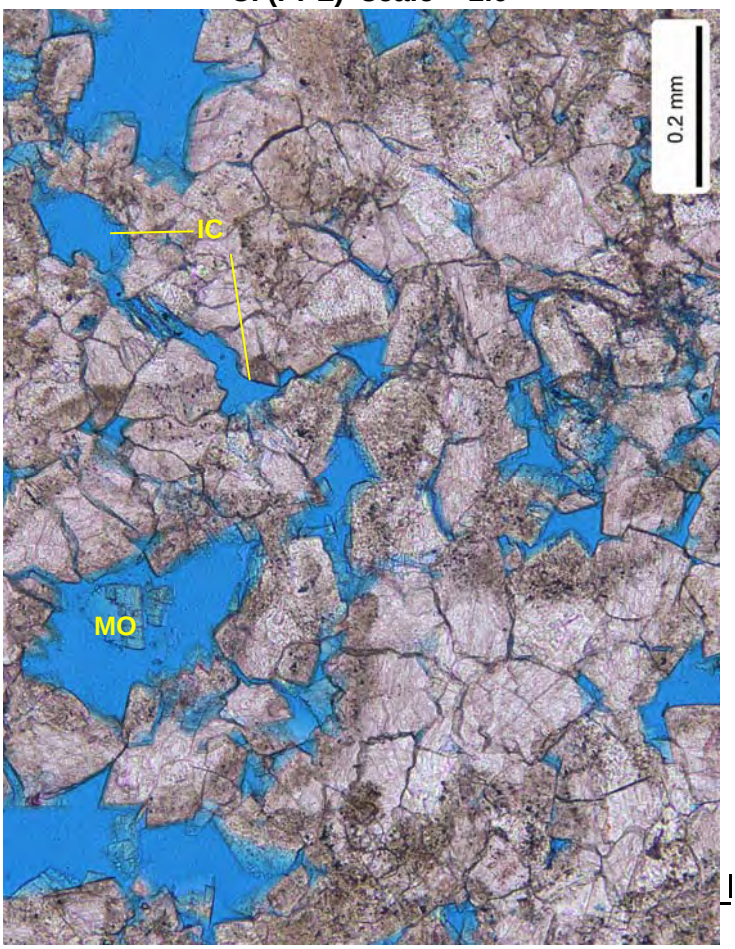


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 2A-2C

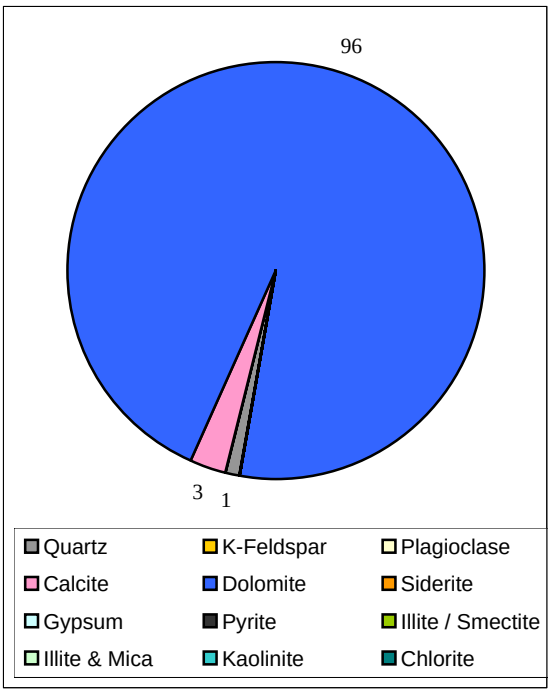
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 1701.9

Like the previous sample, before dolomitization this sample was likely a bioclast grainstone. Unlike the previous sample, most of the recognizable bioclast "ghosts" appear to be mollusk fragments (mol). Peloids (pel) and intraclasts (IN) are also observed. Moldic pores (MO) and vuggy pores (VG) are the most common types of macropores in this dolostone. The moldic pores were formed by the dissolution of bioclasts or large intraclasts; the vuggy pores were formed by more extensive dissolution. Many pores lack or have uncertain textural references and are classified as intercrystal pores (IC). The total amount of macropores (blue) in this sample appear common, and they seem well interconnected. This sample should have good storage/recovery potential.

Mineralogy Determined by X-Ray Diffraction (Weight %)



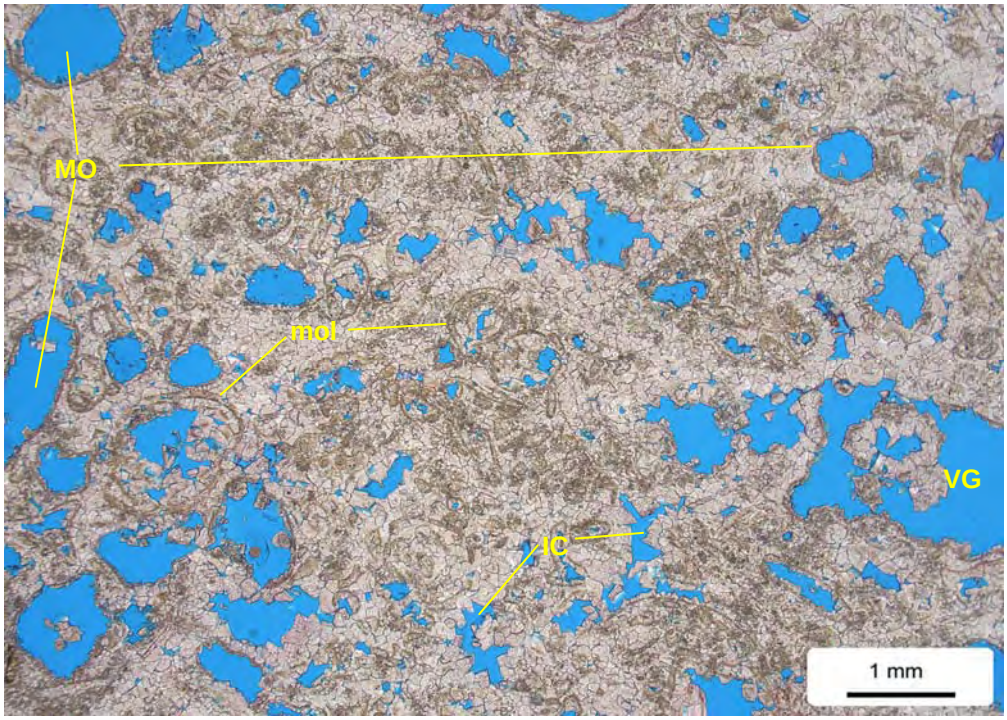
XRD-Whole Rock Mineralogy (Weight %)

Quartz	1	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	3	Total Clay	0
Dolomite	96		

Clay Abundance (Weight %)

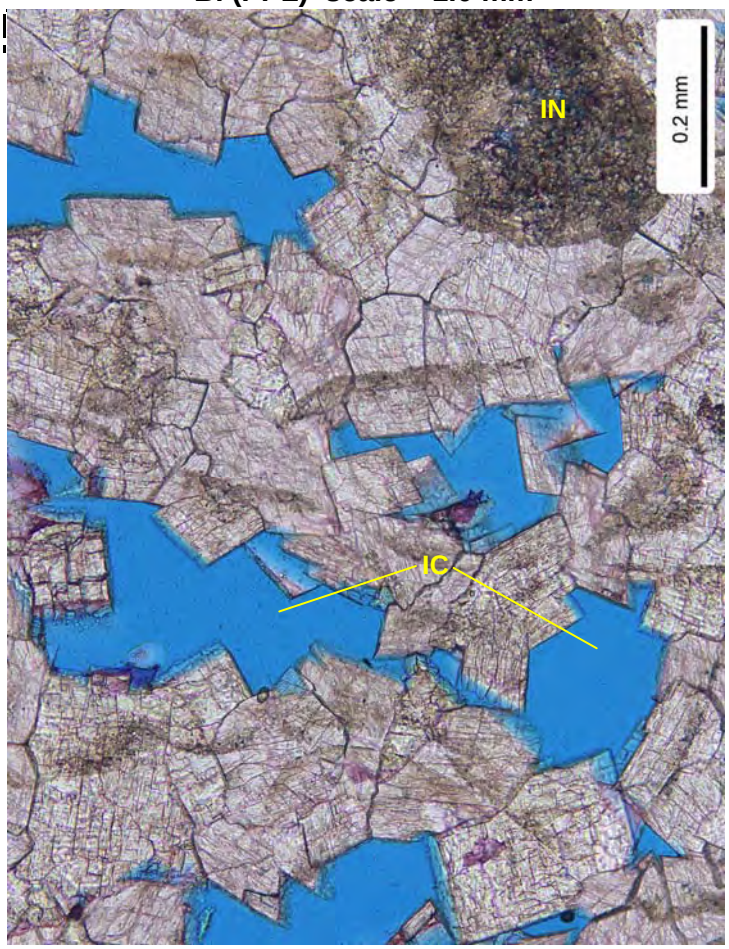
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 2A-2C



A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



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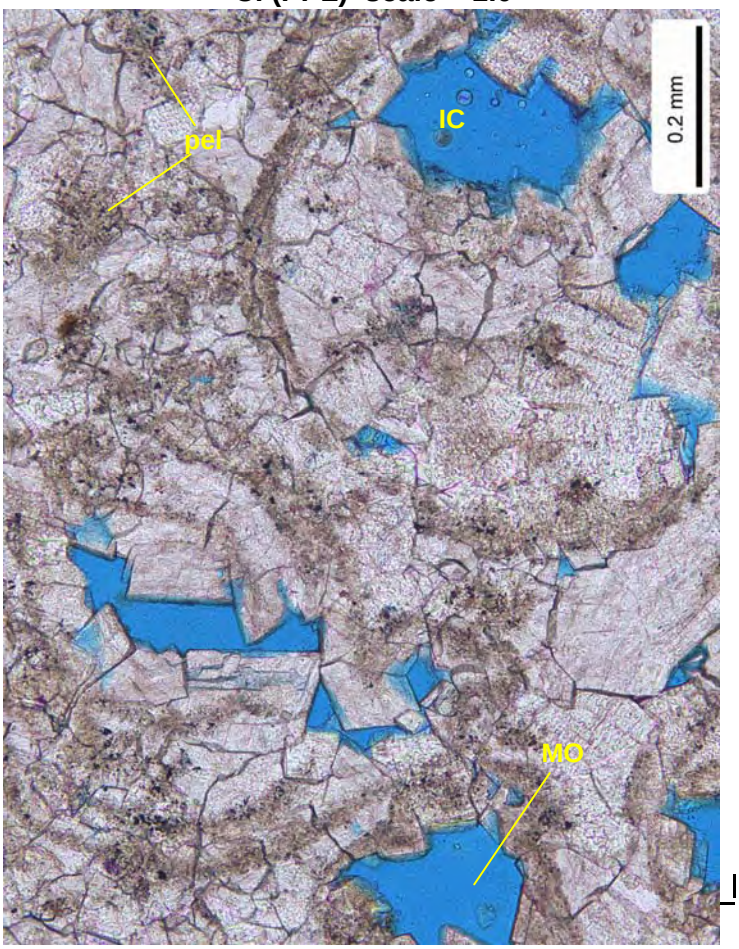


South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 3A-3C

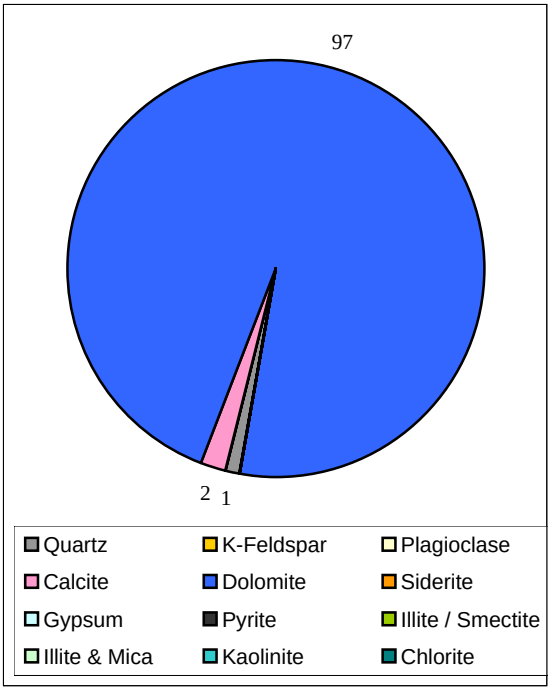
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 1704.2

Dissolution appears more extensive in this dolostone than the previous samples; vuggy pores (VG) and intercrystal pores are the most common type of pore. Vuggy pores (VG) developed where dissolution continued past grain boundaries. Many pores lack or have uncertain textural references and are classified as intercrystal pores (IC). The original texture of this dolostone has been somewhat obscured by dolomite replacement, but was probably a bioclast peloid grainstone. The clay in Plate B is along a thin seam. The clay in Plate C appears more like a clay clast. The abundant macropores (blue) seem well interconnected, suggesting that this sample has good to very good storage/recovery potential.

Mineralogy Determined by X-Ray Diffraction (Weight %)



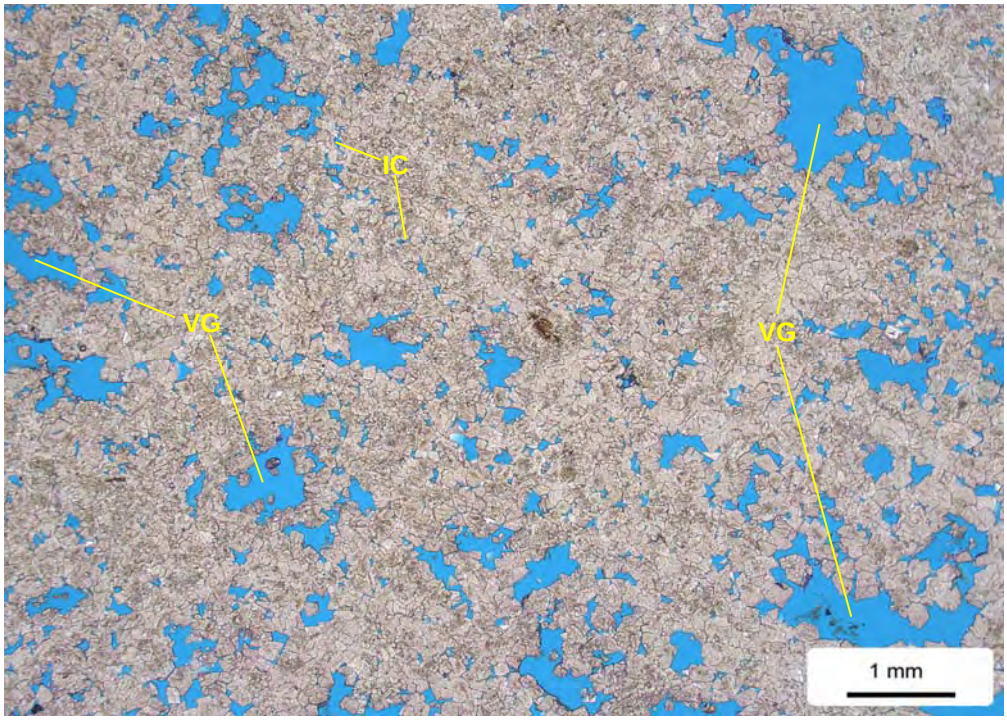
XRD-Whole Rock Mineralogy (Weight %)

Quartz	1	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	2	Total Clay	0
Dolomite	97		

Clay Abundance (Weight %)

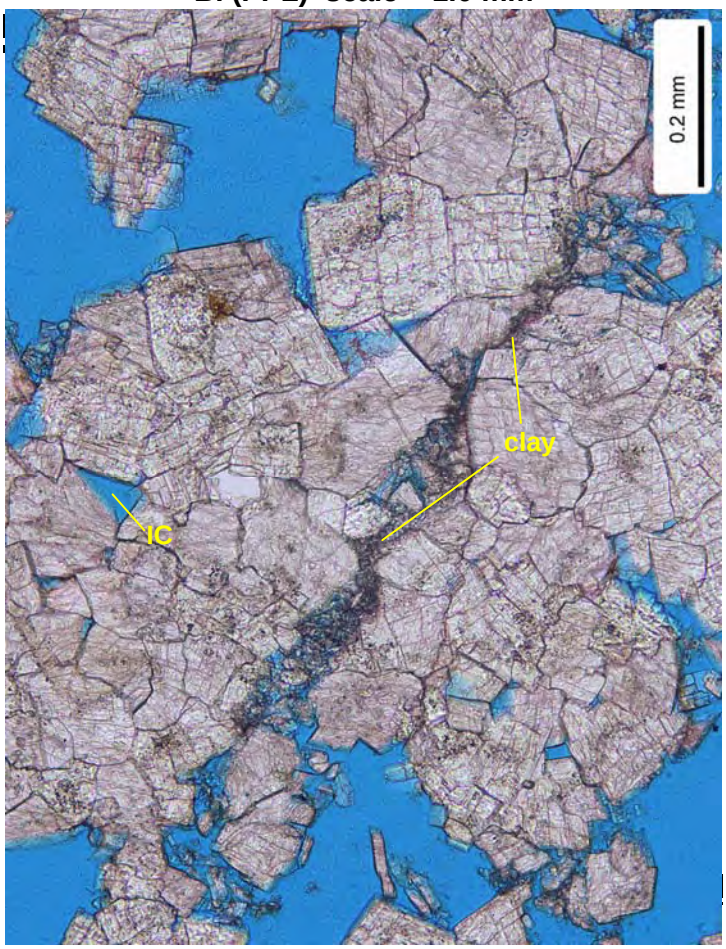
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 3A-3C

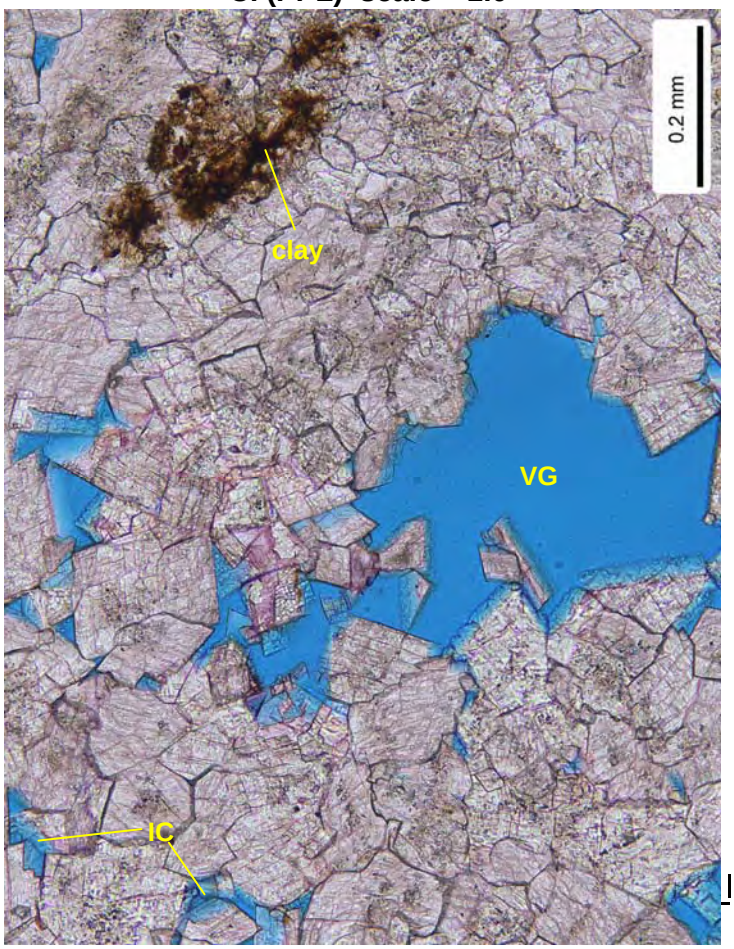


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 4A-4C

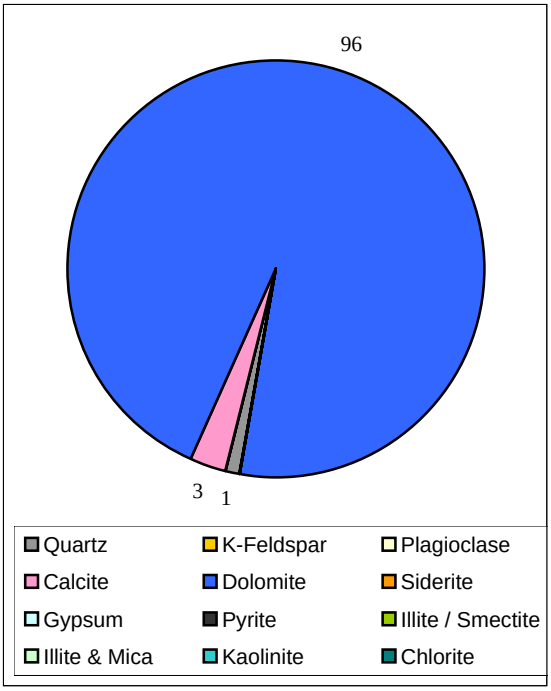
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 1706.0

Before dolomitization this sample was likely a peloid grainstone. The remnant of a gastropod (gst) and a peloid (P) can be identified; most allochemical grains were rendered unrecognizable by the dolomitization. Moldic pores (MO) and intercrystal pores (IC) are the most common types of macropores in this dolostone. The moldic pores were formed by the dissolution of bioclasts or large intraclasts; those pores that lack or have uncertain textural references and are classified as intercrystal pores (IC). The total amount of macropores (blue) in this sample appear common. This sample should have good storage/recovery potential.

Mineralogy Determined by X-Ray Diffraction (Weight %)



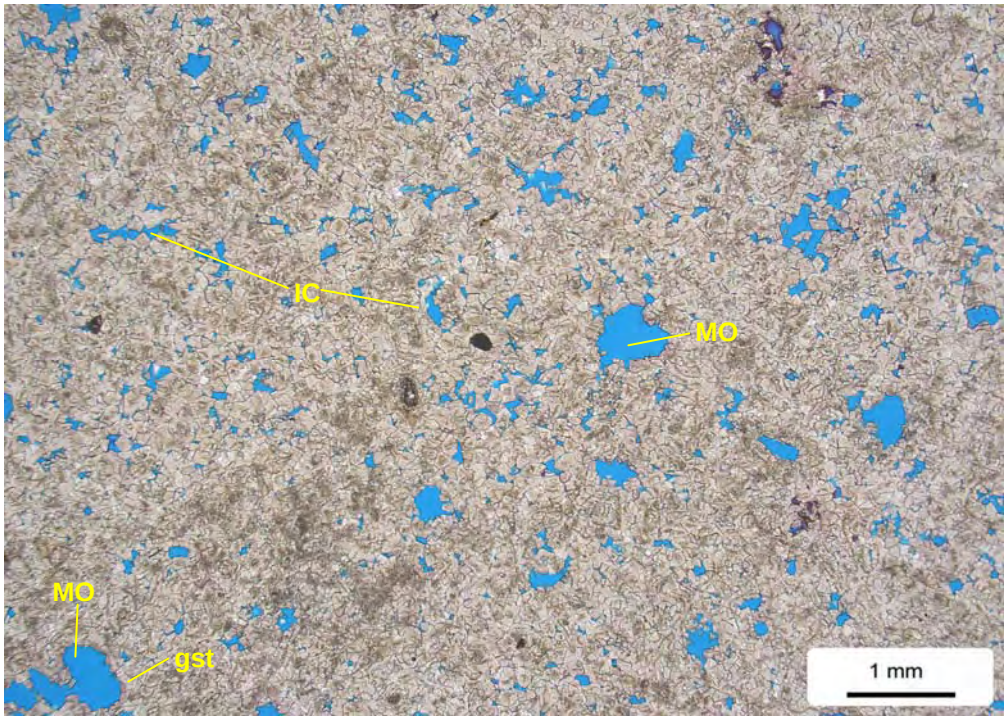
XRD-Whole Rock Mineralogy (Weight %)

Quartz	1	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	3	Total Clay	0
Dolomite	96		

Clay Abundance (Weight %)

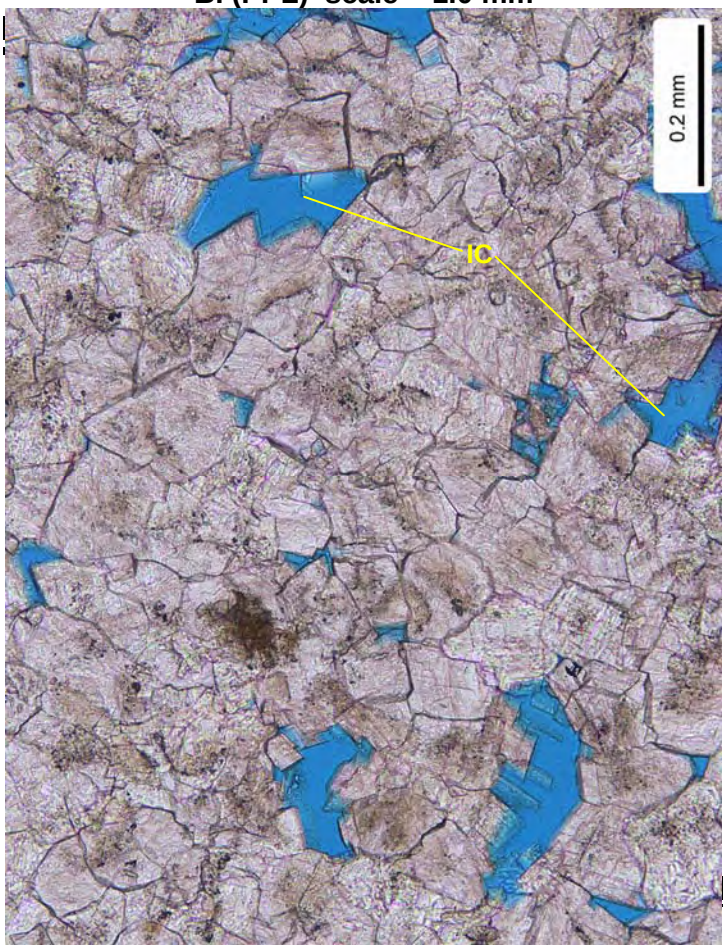
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 4A-4C

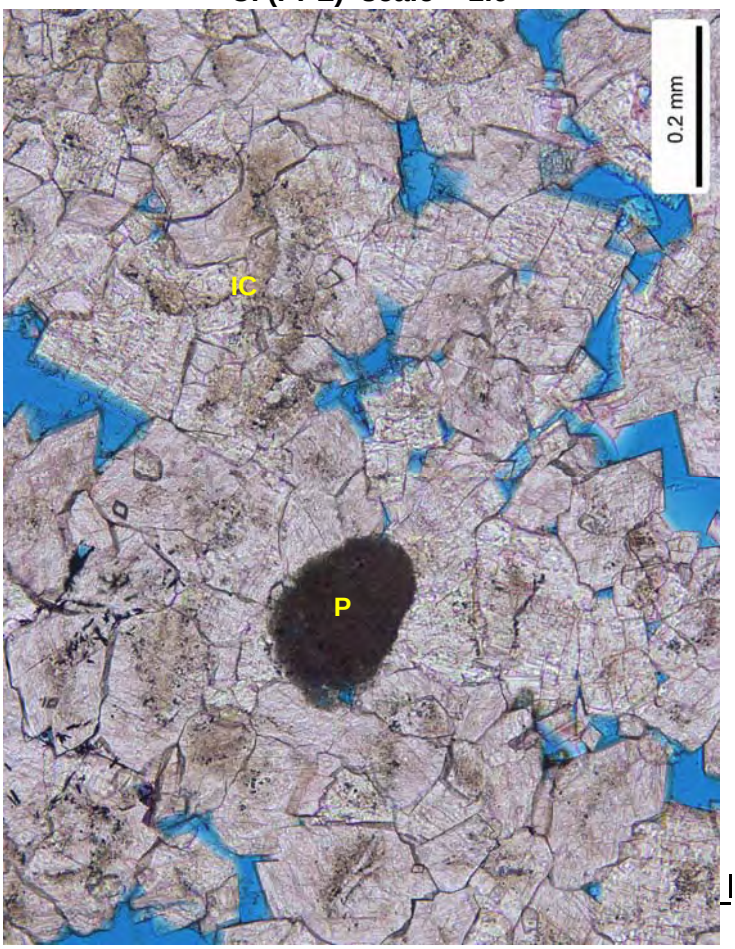


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 5A-5C

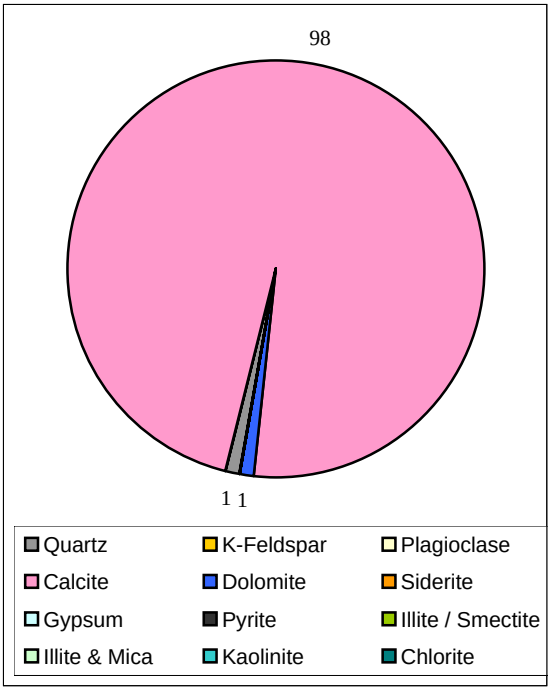
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2100.9

This sample is an upper fine-grained bioclast peloid grainstone; sorting and compaction are moderate. Calcite cement has two basic types, an early pore-fringing cement (cal1) and a later syntaxial pore-filing cement (cal2). The syntaxial calcite cement preferentially nucleates on echinoderm grains (ech). Primary between particle pores (PBP) are common and appear well inerconnected; primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Vuggy pores (VG) and other secondary pores are rare. Bioclasts include benthic foraminifera (miliolids and rotalids), dasyclad algal grains, red algae (rd) and mollusks. Other allochemical grains include intraclasts (IN) and peloids (P).

Mineralogy Determined by X-Ray Diffraction (Weight %)



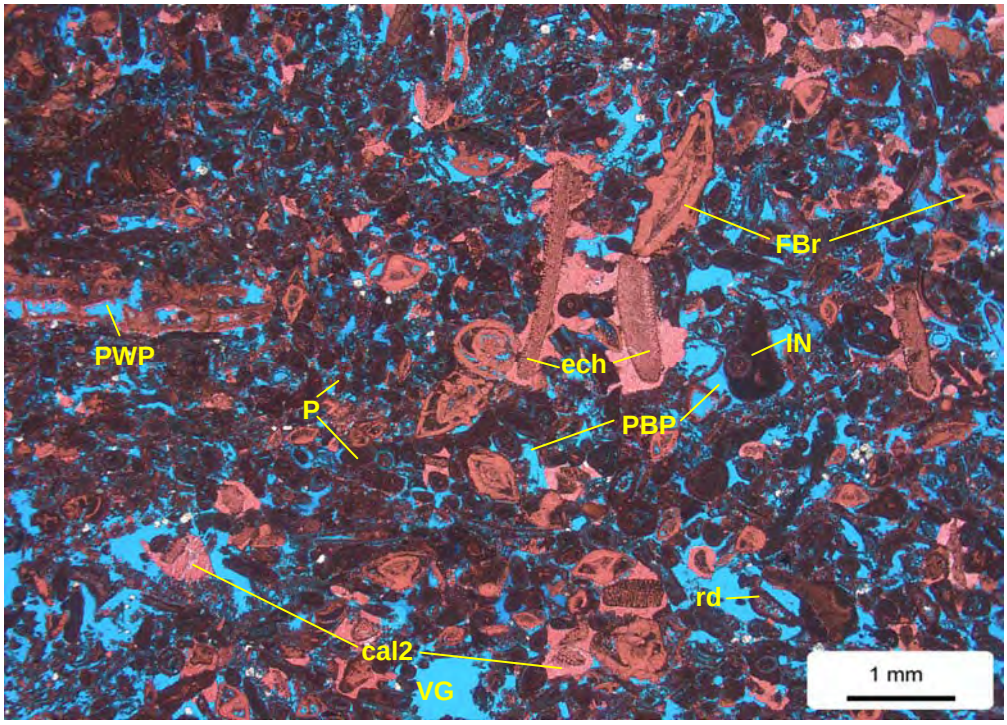
XRD-Whole Rock Mineralogy (Weight %)

Quartz	1	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	98	Total Clay	0
Dolomite	1		

Clay Abundance (Weight %)

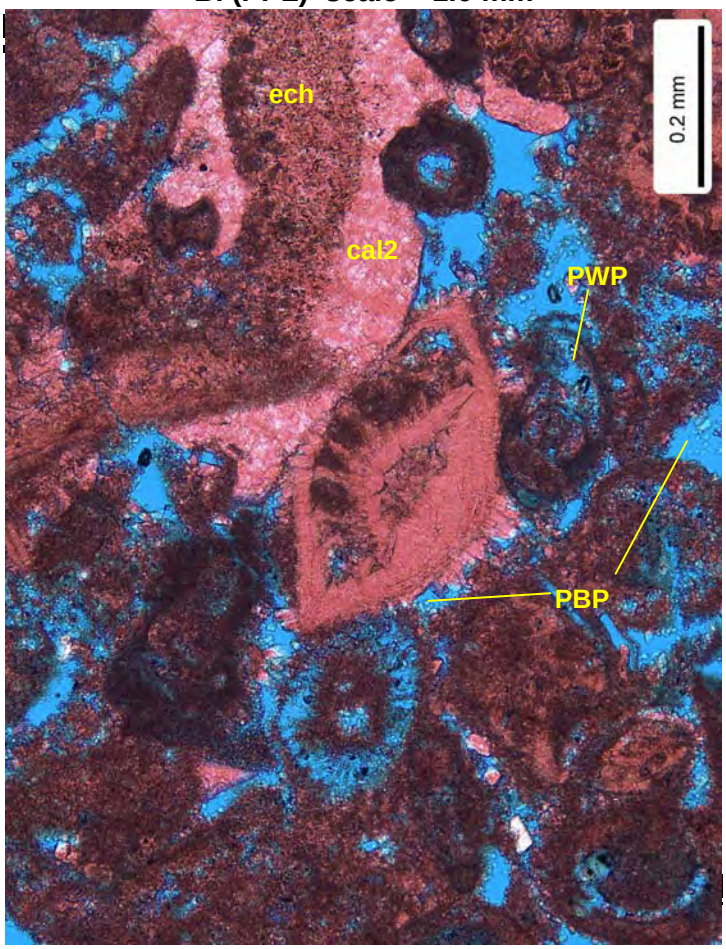
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 5A-5C

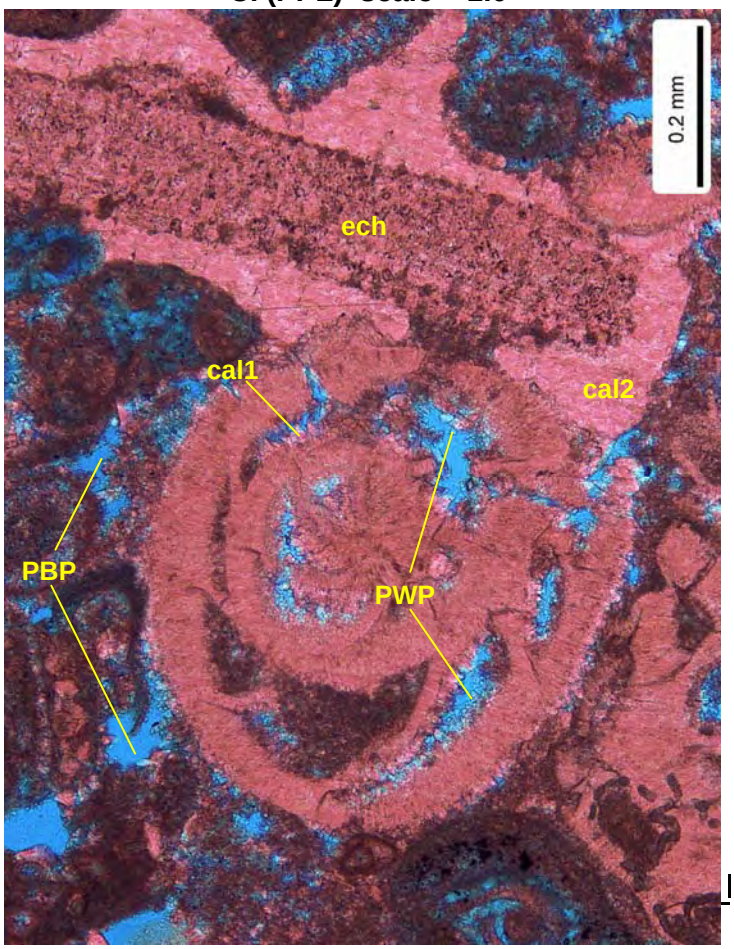


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 6A-6C

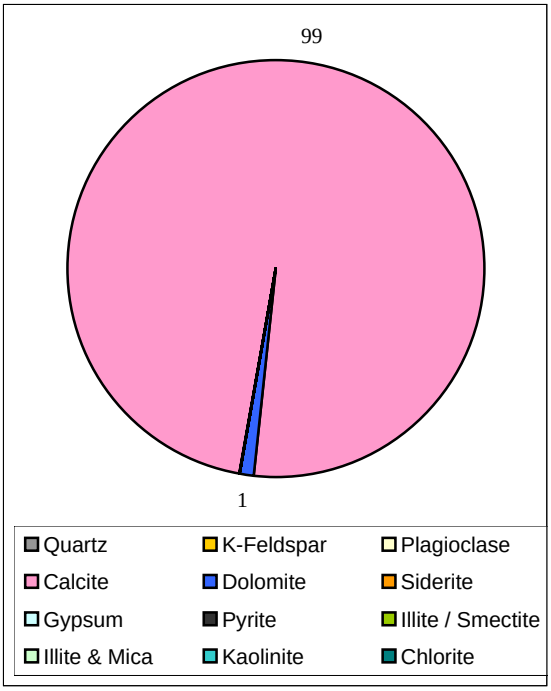
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2101.9

Bioclasts in this poorly sorted, upper fine-grained bioclast mud-lean packstone include benthic foraminifera (miliolids and rotalids (FBr)), echinoderms (ech) dasyclad algal grains, red algae (rd) and mollusks (mol). Other allochemical grains include intraclasts and peloids (P). Calcite cement comes in two basic types, an early pore-fringing cement (cal1) and a later syntaxial pore-filing cement (cal2). Authigenic dolomite (dol) is a minor cement; pyrite (py) is commonly associated with bioclasts. Primary between particle pores (PBP) are common and appear well inerconnected; primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Moldic pores (VG) and secondary within particle pores (SWP) are less abundant.

Mineralogy Determined by X-Ray Diffraction (Weight %)



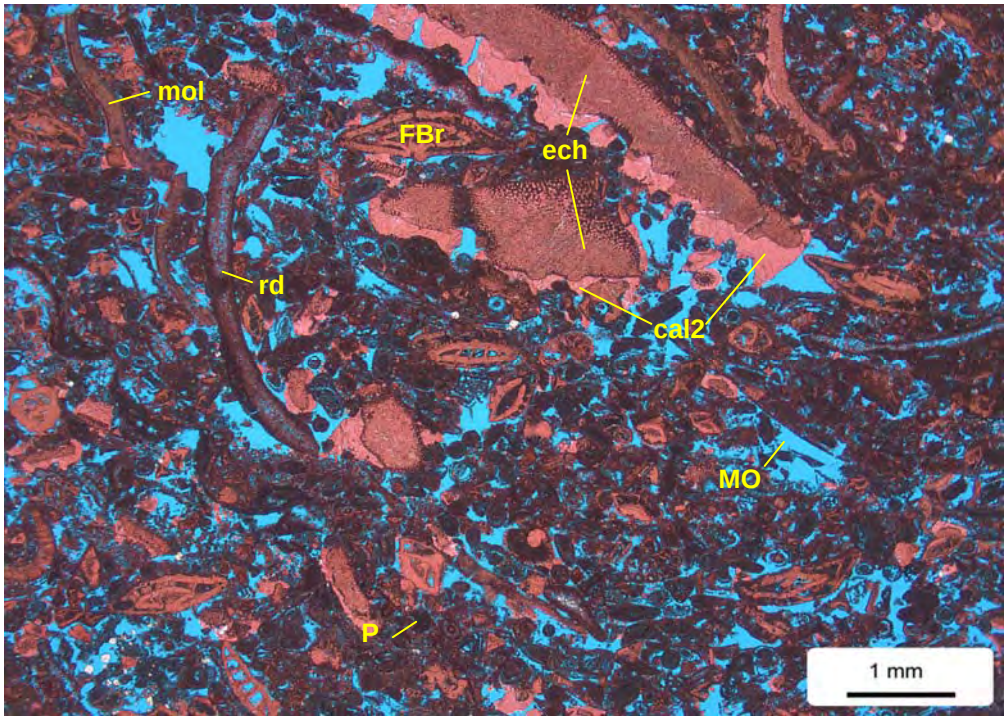
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	99	Total Clay	0
Dolomite	1		

Clay Abundance (Weight %)

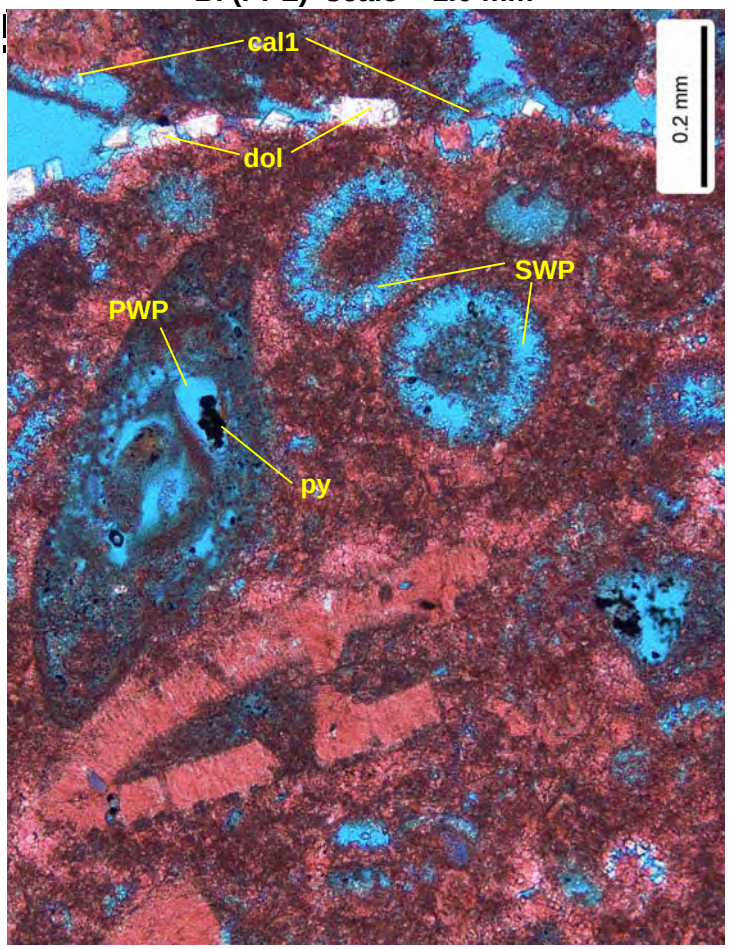
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 6A-6C

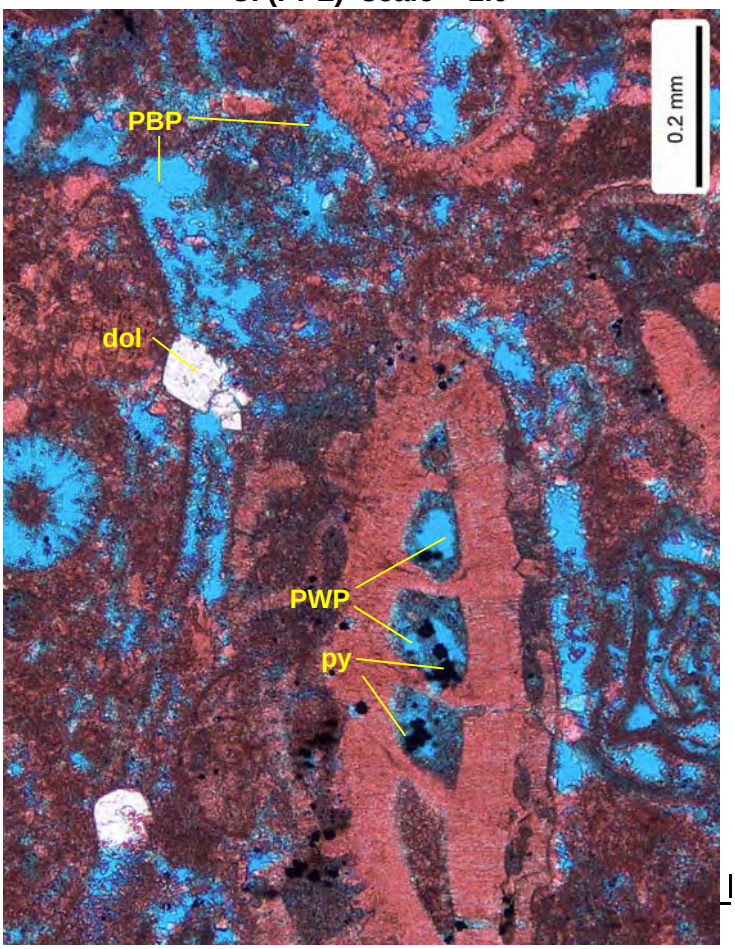


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 7A-7C

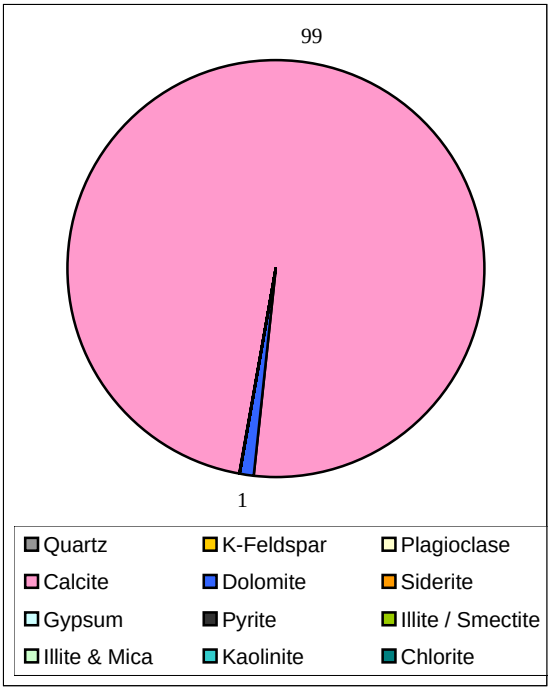
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2103.1

In this poorly sorted bioclast grainstone, the calcite cement has two basic varieties, an early pore-fringing cement (cal1) and a later syntaxial pore-filing cement (cal2). Overall, pore-filling cements are minor in abundance. Dolomite (dol) and pyrite (py) are trace cements. Primary between particle pores (PBP) are common and appear well inerconnected; primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Vuggy pores (VG) and other secondary pores are rare. Bioclasts include benthic foraminifera (miliolids and rotalids), dasyclad algal grains, red algae (rd) and mollusks (mol). Other allochemical grains include intraclasts and peloids.

Mineralogy Determined by X-Ray Diffraction (Weight %)



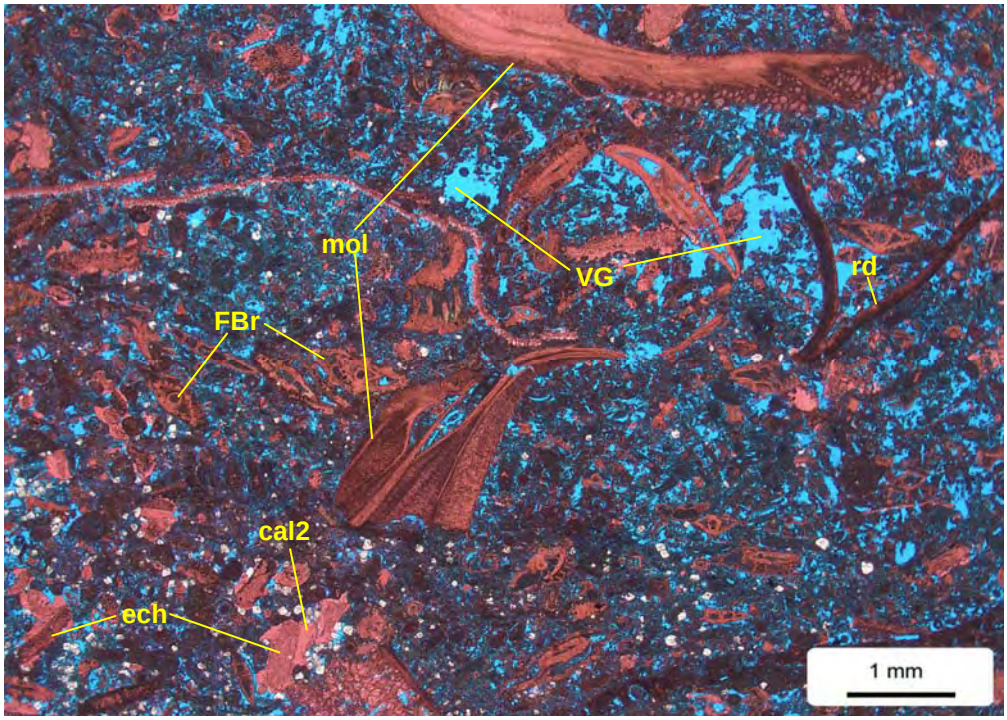
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	99	Total Clay	0
Dolomite	1		

Clay Abundance (Weight %)

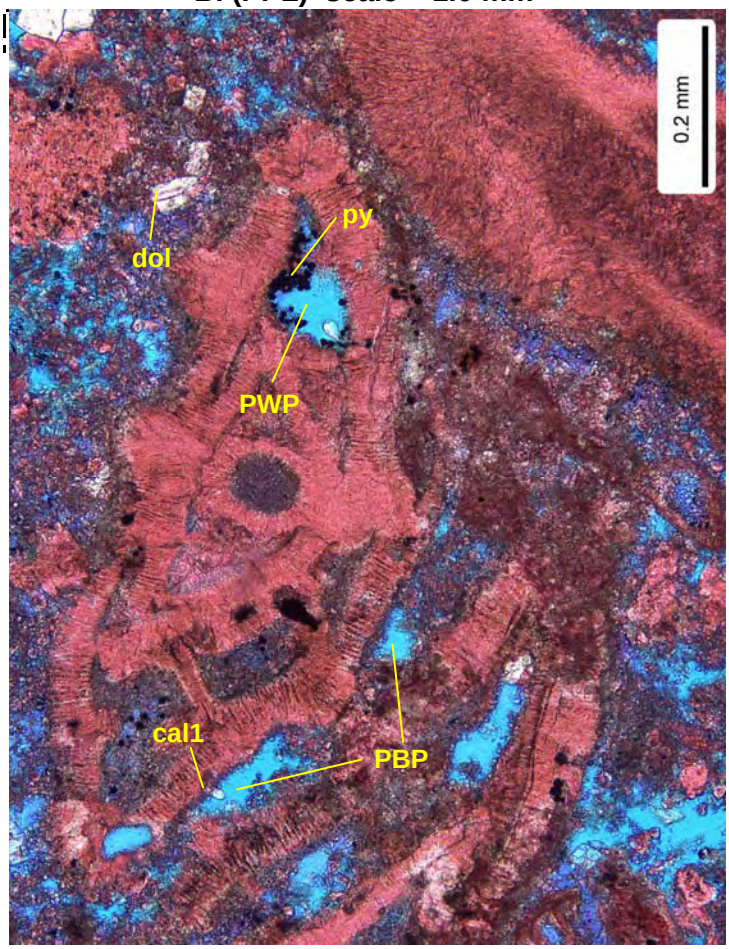
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 7A-7C

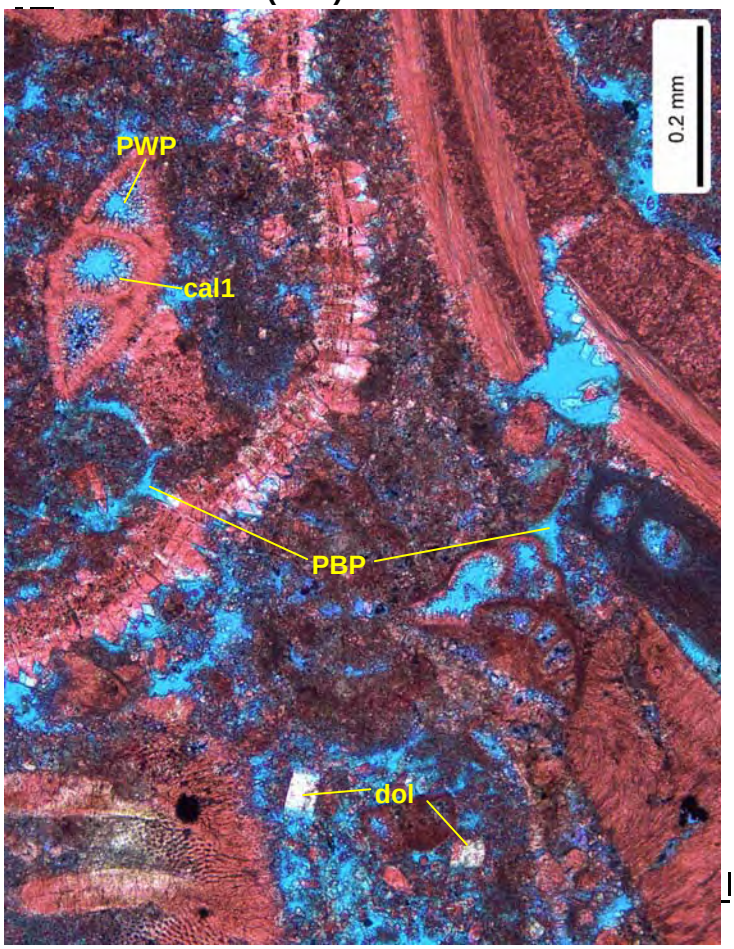


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 8A-8C

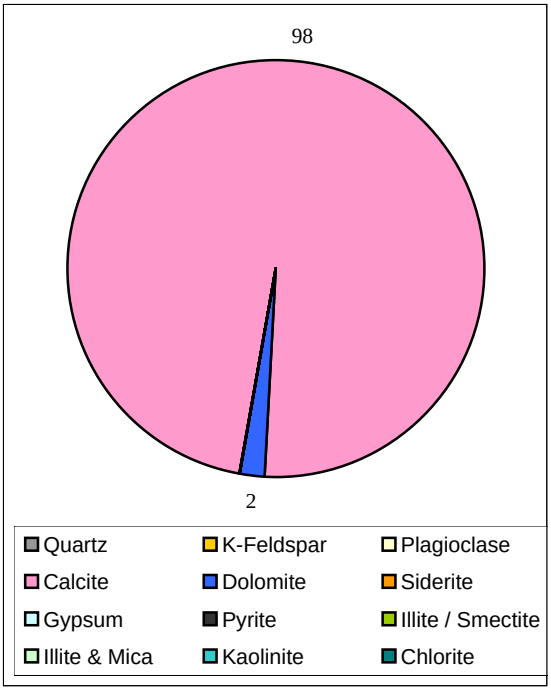
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2104.1

Primary between particle pores (PBP) in this upper fine-grained bioclast packstone are common and appear well interconnected; primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Moldic pores (MP) are more common in this sample than in many of the previous limestones; the morphology of the molds suggest that they may have been mollusk grains. Overall, macropores are very common. Bioclasts include benthic foraminifera (miliolids and rotalids (FBr), dasyclad algal grains and red algae (rd). Other allochemical grains include intraclasts and peloids. Early pore-fringing cement (cal1) is locally observed; authigenic dolomite (dol) is a minor mineral in this sample.

Mineralogy Determined by X-Ray Diffraction (Weight %)



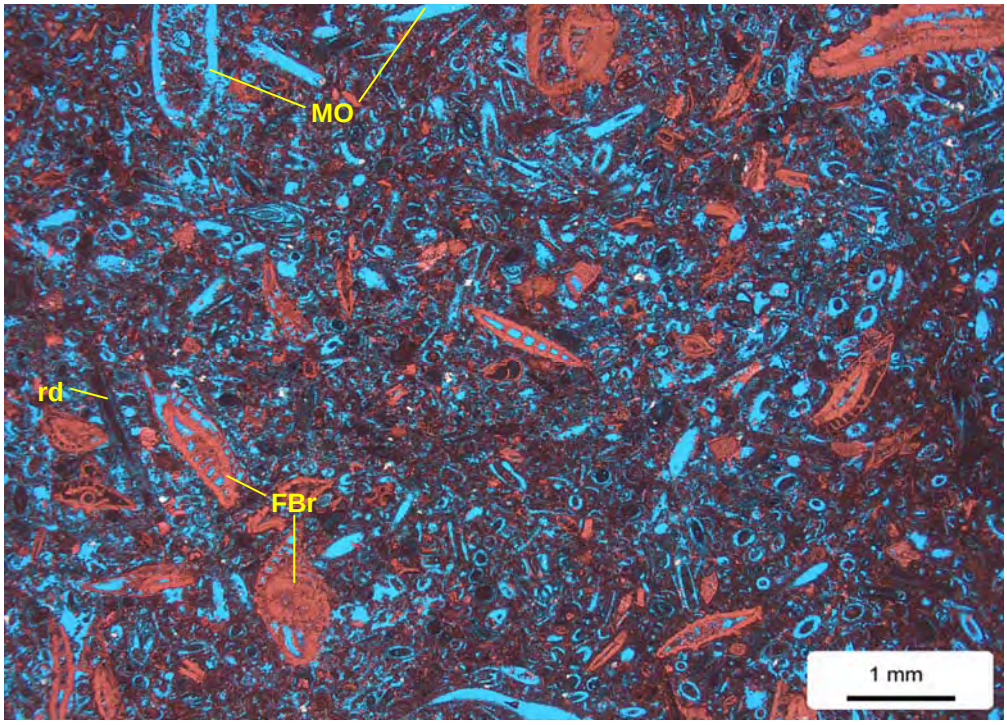
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	98	Total Clay	0
Dolomite	2		

Clay Abundance (Weight %)

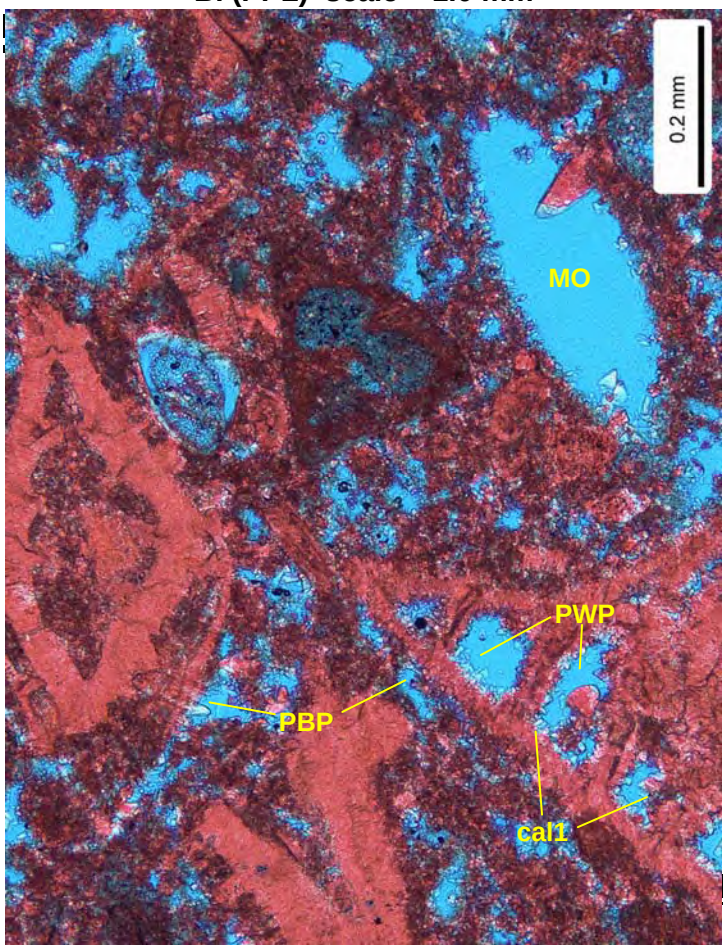
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 8A-8C

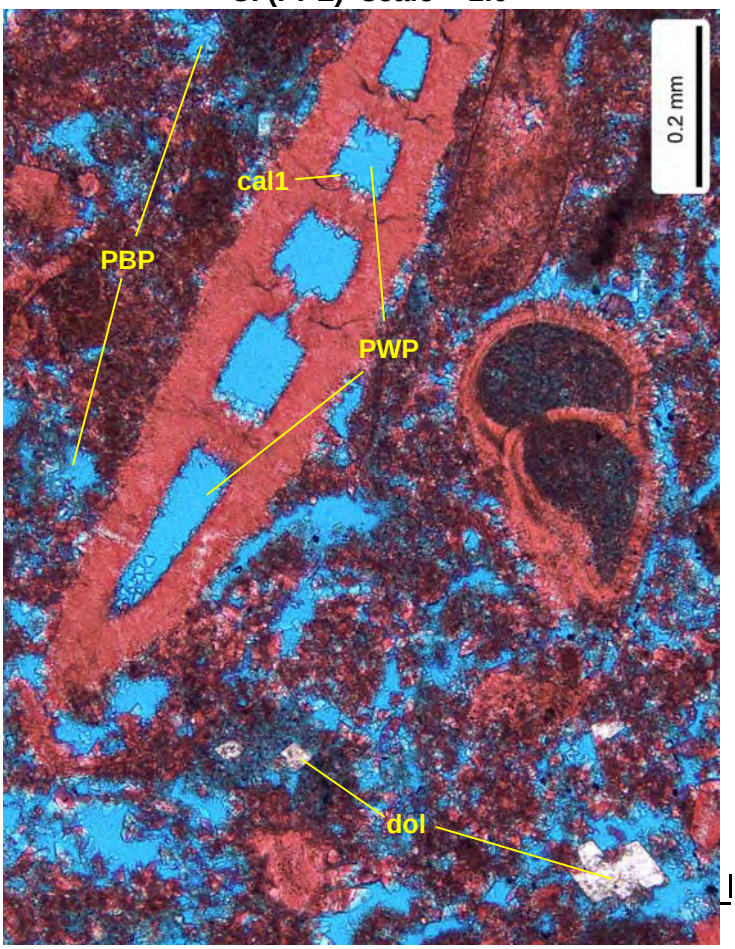


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 9A-9C

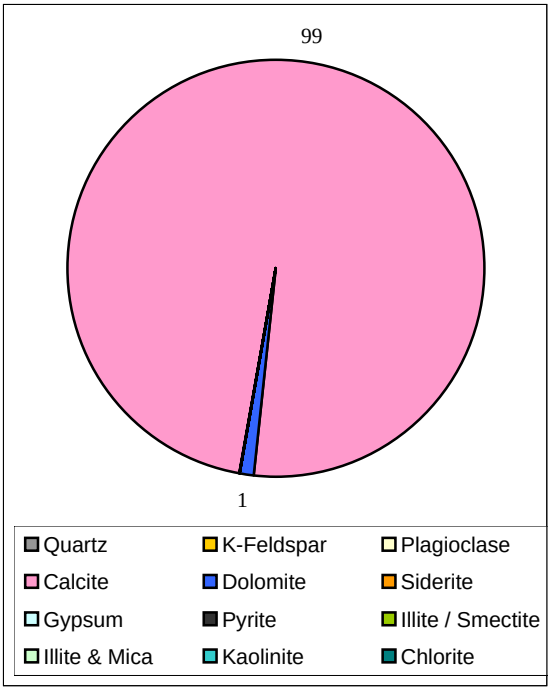
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2105.1

This sample is an bioclast peloid packstone; micrite matrix is common and fills most interparticle areas. Calcite cement comes in two basic varieties, and early pore-fringing cement (cal1) an a later syntaxial pore-filing cement (cal2). The later syntaxial calcite cement nucleated on echinoderm grains (ech) and filled local primary between particle pores (PBP). Authigenic dolomite (dol) and pyrite (py) are minor constituents of this sample. Both primary between particle pores and primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Secondary pores are also minor to rare. Bioclasts include benthic foraminifera (miliolids and rotalids(FBr)), planktonic foraminifera (FP) and mollusks. Other allochemical grains include intraclasts and peloids (P).

Mineralogy Determined by X-Ray Diffraction (Weight %)



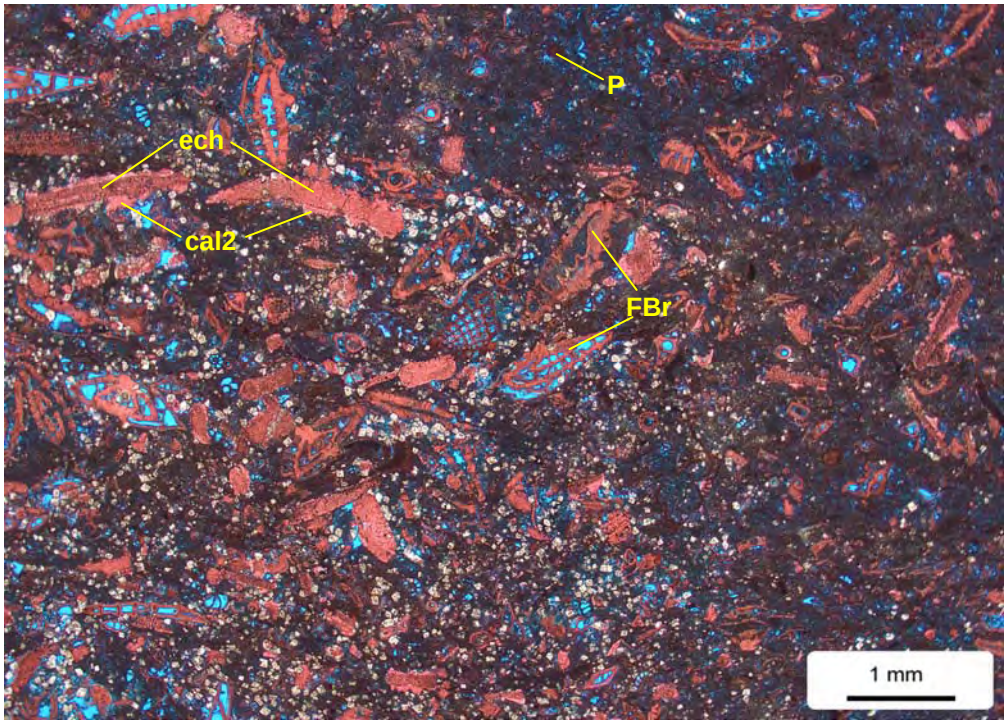
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	99	Total Clay	0
Dolomite	1		

Clay Abundance (Weight %)

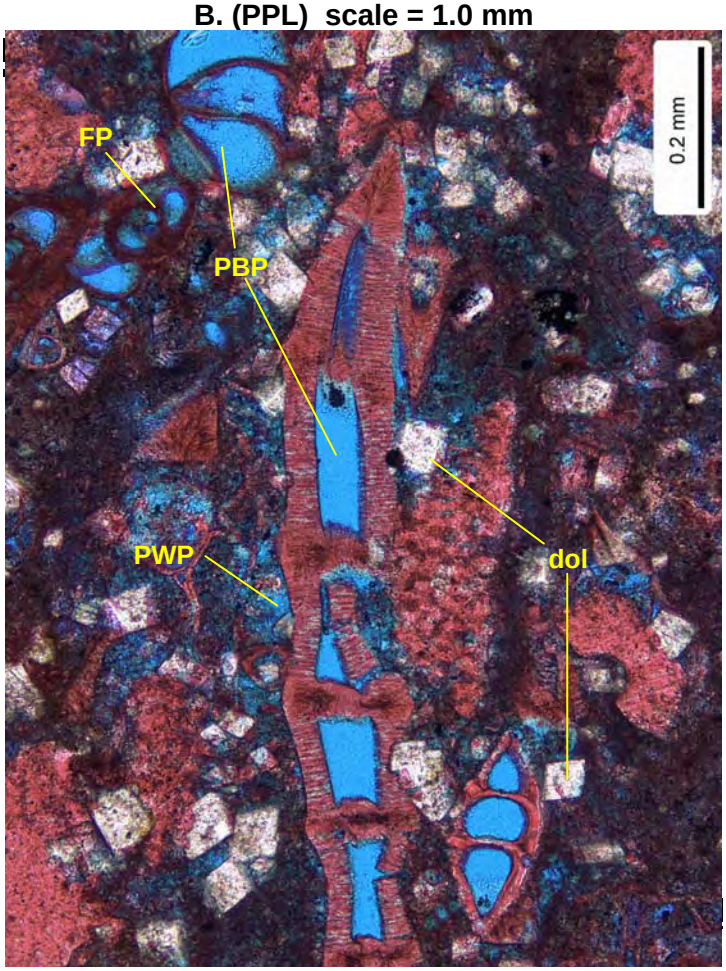
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 9A-9C

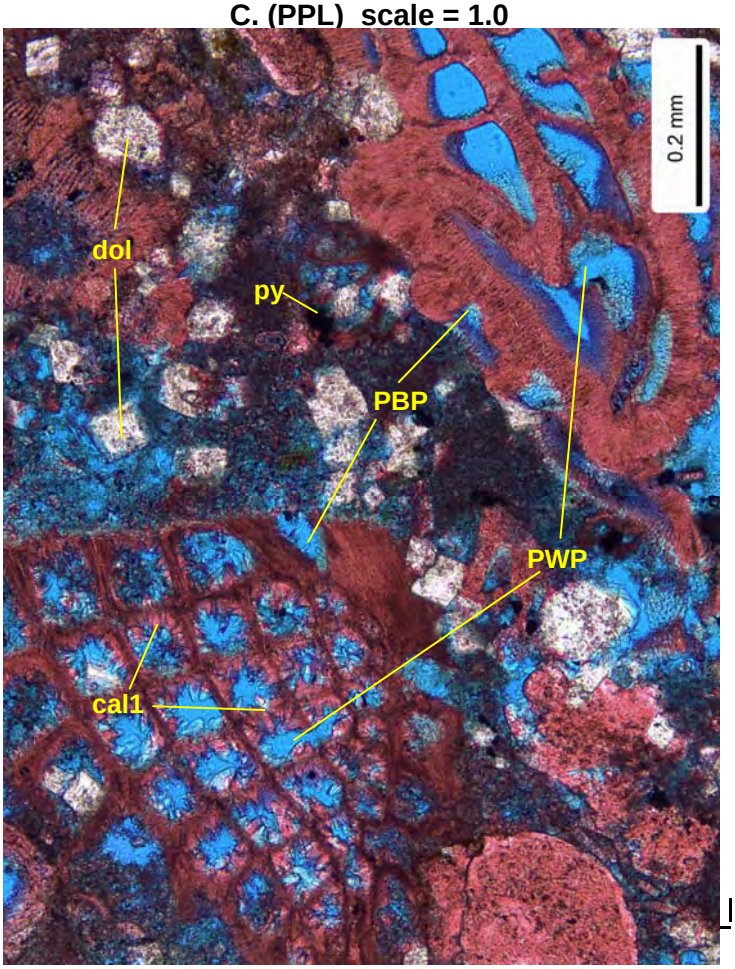


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 10A-10C

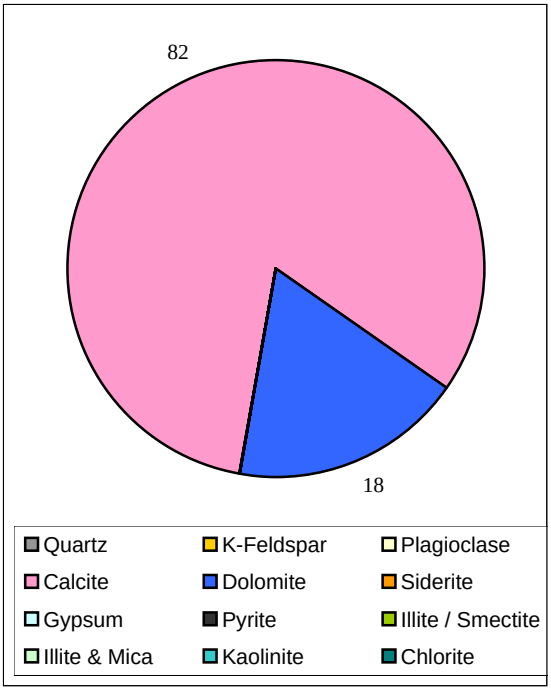
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2106.4

Bioclasts in this dolomitic bioclast packstone include benthic foraminifera (miliolids and rotalids (FBr)), gastropods (gst), echinoderms (ech) and mollusks. Other allochemical grains include intraclasts and peloids. Early pore-fringing cement (cal1) is very rare; authigenic dolomite (dol) is a common mineral, replacing matrix and locally filling pores. Primary between particle pores (PBP) are moderate to common in abundance; primary within particle pores (PWP; mostly within benthic foramnifera) are minor. Moldic pores (VG) and other secondary pores are less abundant.

Mineralogy Determined by X-Ray Diffraction (Weight %)



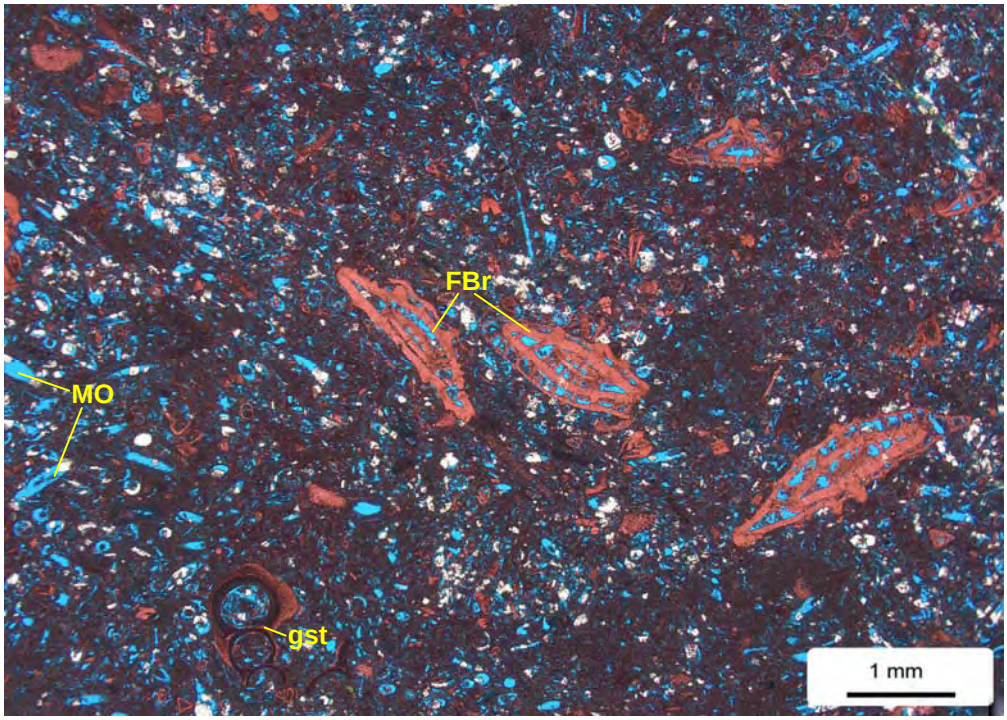
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	82	Total Clay	0
Dolomite	18		

Clay Abundance (Weight %)

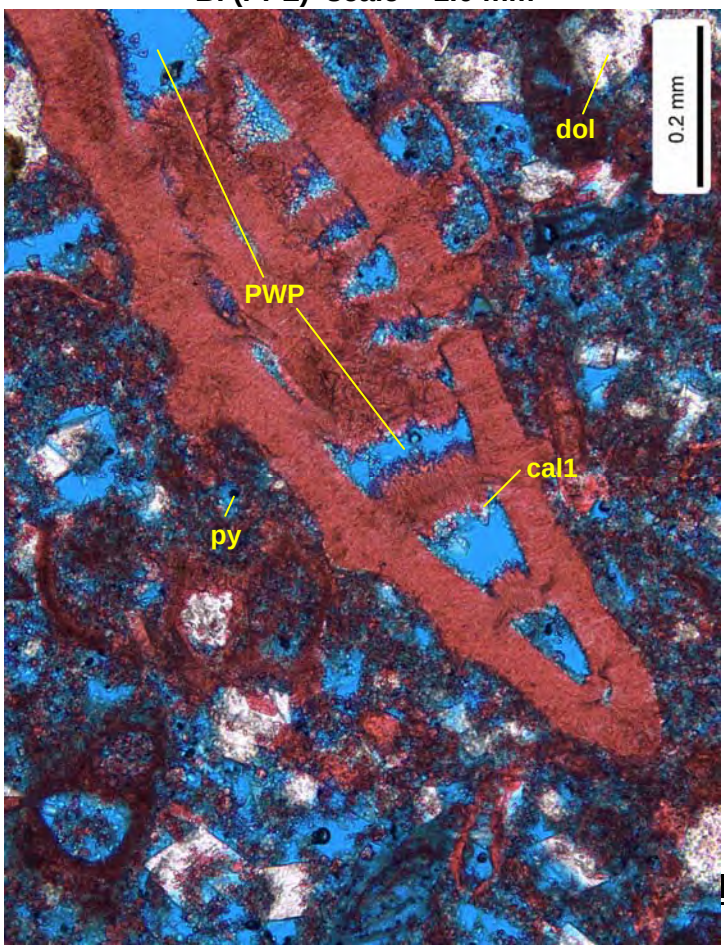
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 10A-10C

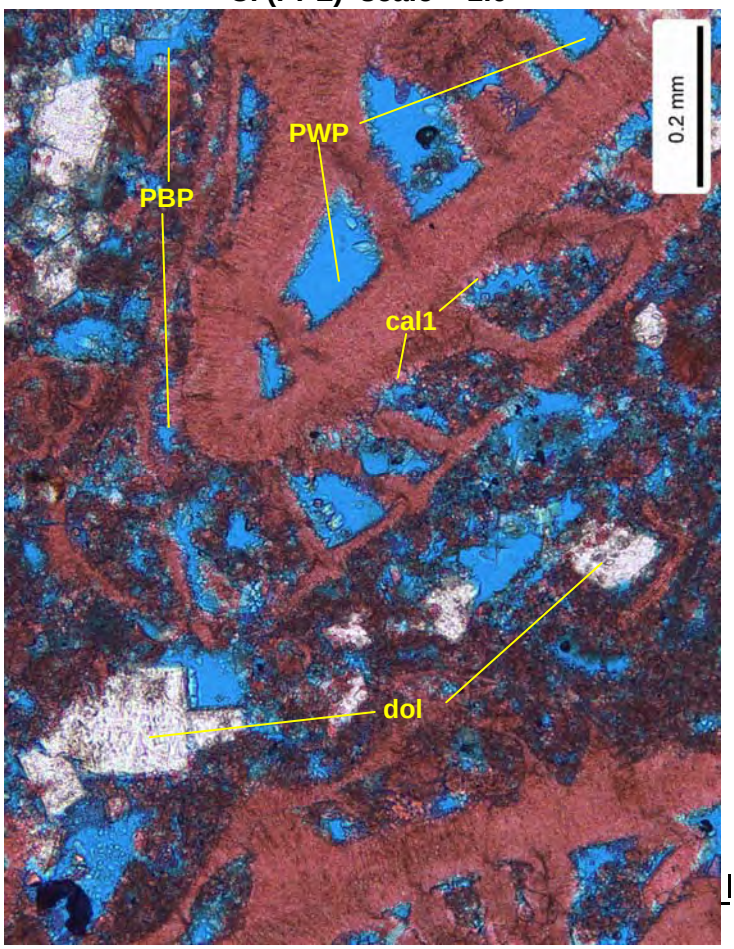


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 11A-11C

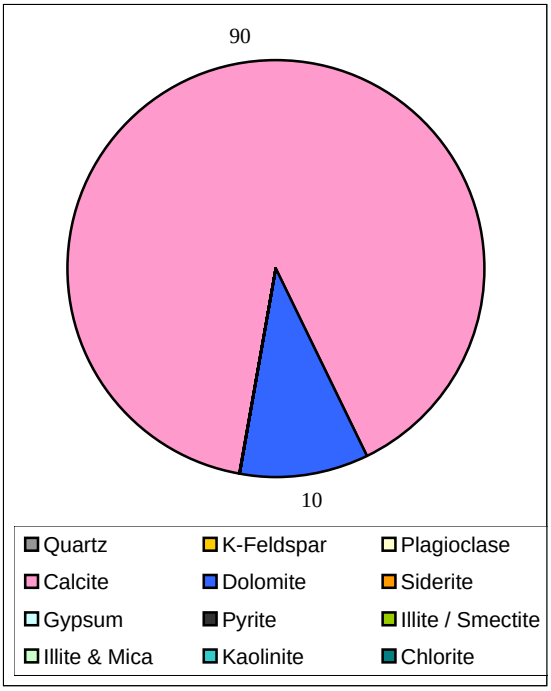
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2107.6

In this dolomitic lime packstone one of the first minerals to form was pore-fringing cement (cal1). This calcite partially filled in primary intraparticle and interparticle pores. Later authigenic dolomite (dol) further filled in primary interparticle pores and replaced portions of grains and matrix. Primary between particle pores (PBP) are minor as are primary within particle pores (PWP; mostly within benthic foramnifera). Some secondary within particle pores are noted, overall secondary pores are rare. Bioclasts include benthic foraminifera (miliolids and rotalids), planktonic foraminifera (FP), echinoderms (ech), bryozoans and mollusks. Other allochemical grains include intraclasts and peloids.

Mineralogy Determined by X-Ray Diffraction (Weight %)



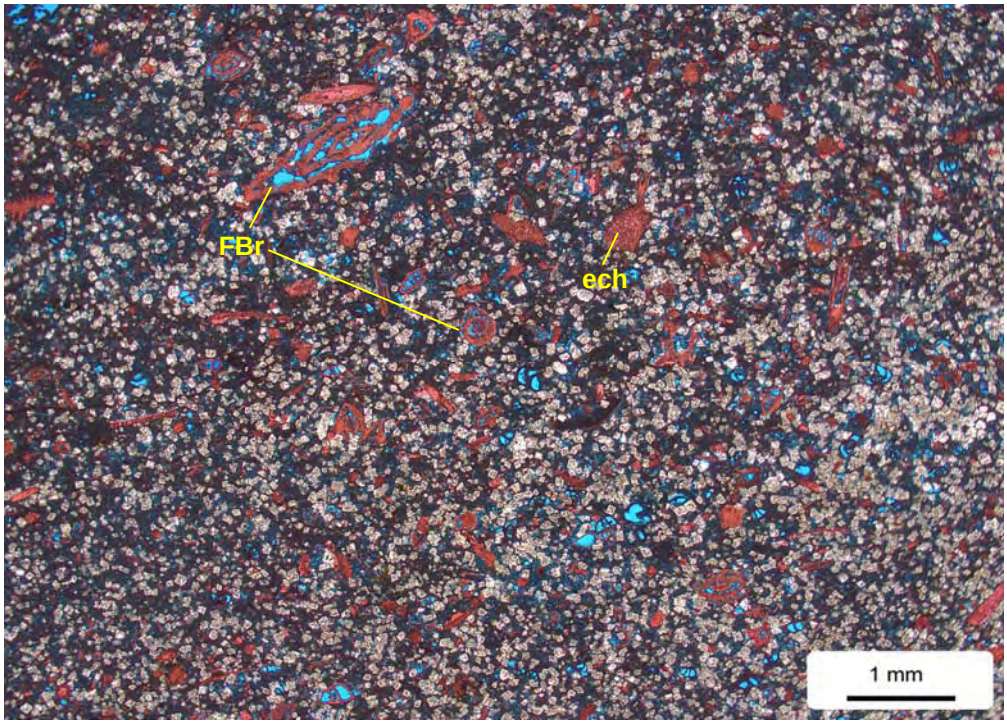
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	90	Total Clay	0
Dolomite	10		

Clay Abundance (Weight %)

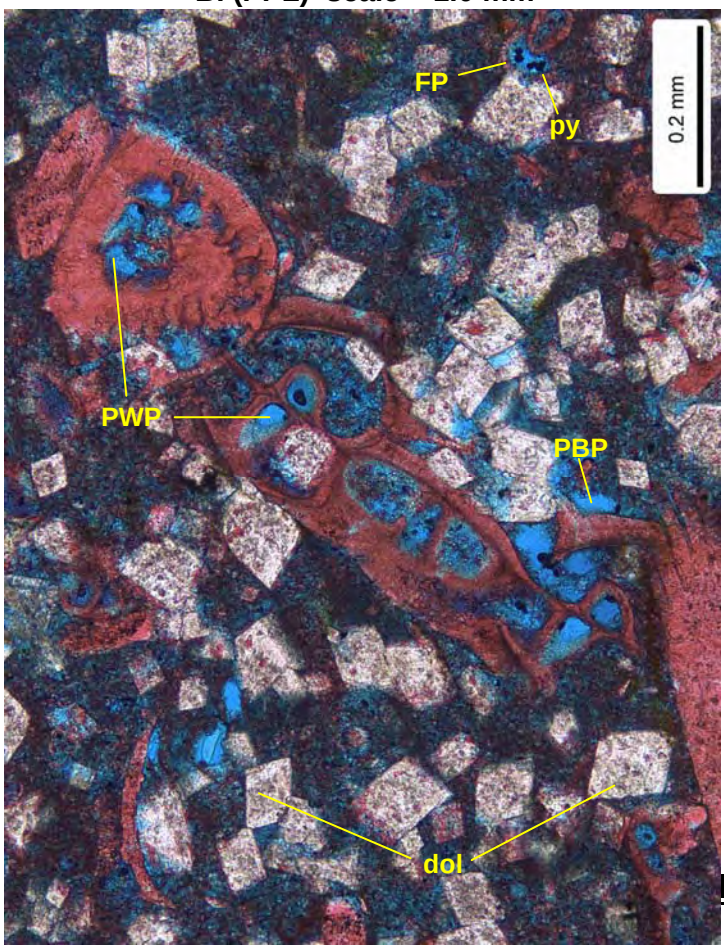
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 11A-11C

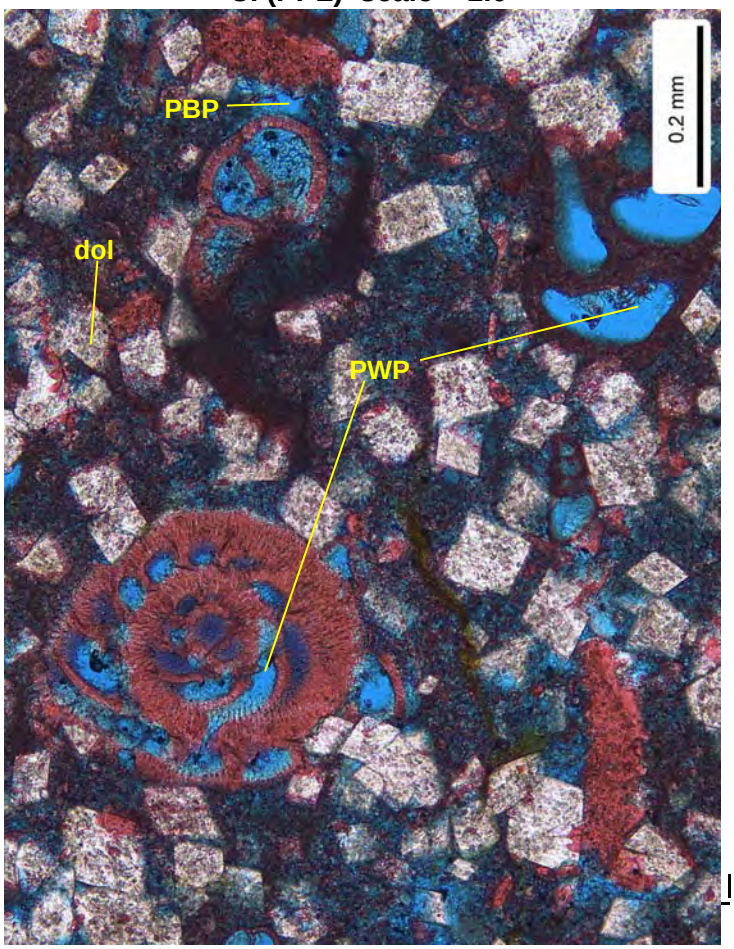


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 12A-12C

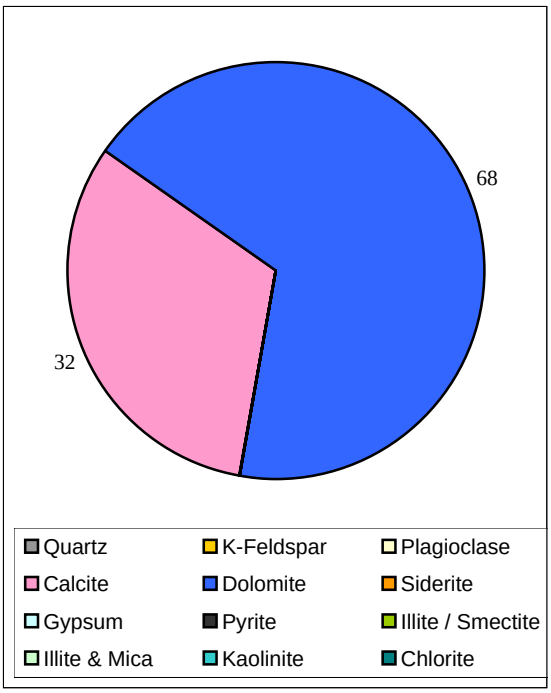
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2110.2

This bioclast peloid dolopackstone most of the allochemical grains and matrix were repalced by dolomite. Early pore-fringing cement and later syntaxial pore-filing cement were either poorly developed or replaced by the dolomite (dol). Authigenic pyrite (py) is a minor constituents of this sample. Both primary between particle pores (PBP) and primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Secondary pores are also minor to rare. Overall macropores are moderate to common in this sample, although they may not be well interconnected. Bioclasts include benthic foraminifera (miliolids and rotalids(FBr)) echinoderms (ech) and mollusks (mol).

Mineralogy Determined by X-Ray Diffraction (Weight %)



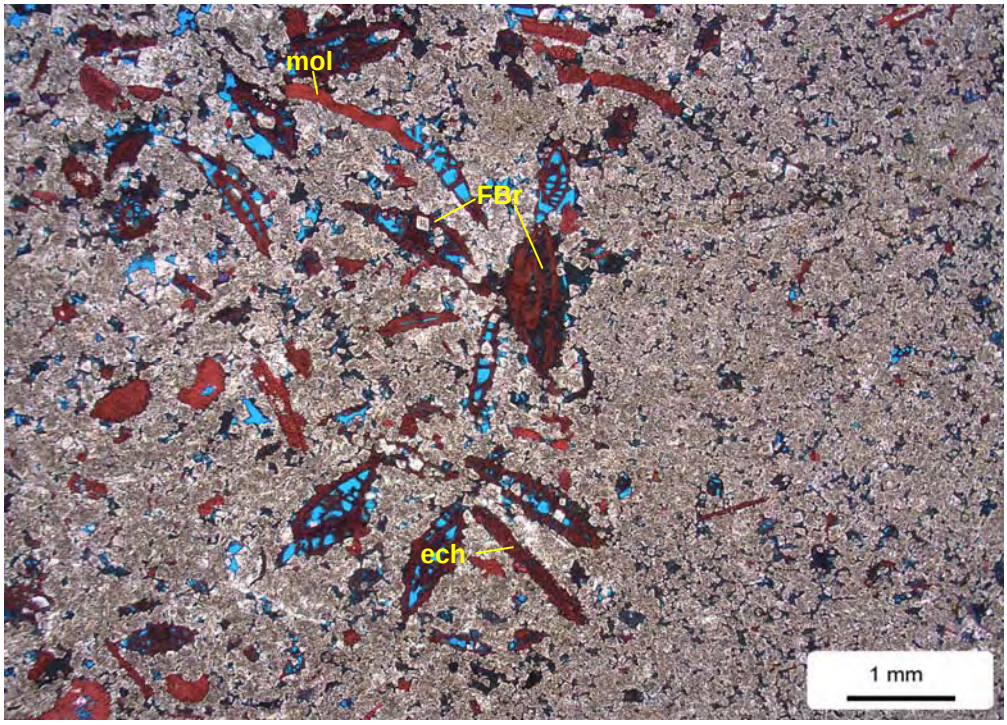
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	32	Total Clay	0
Dolomite	68		

Clay Abundance (Weight %)

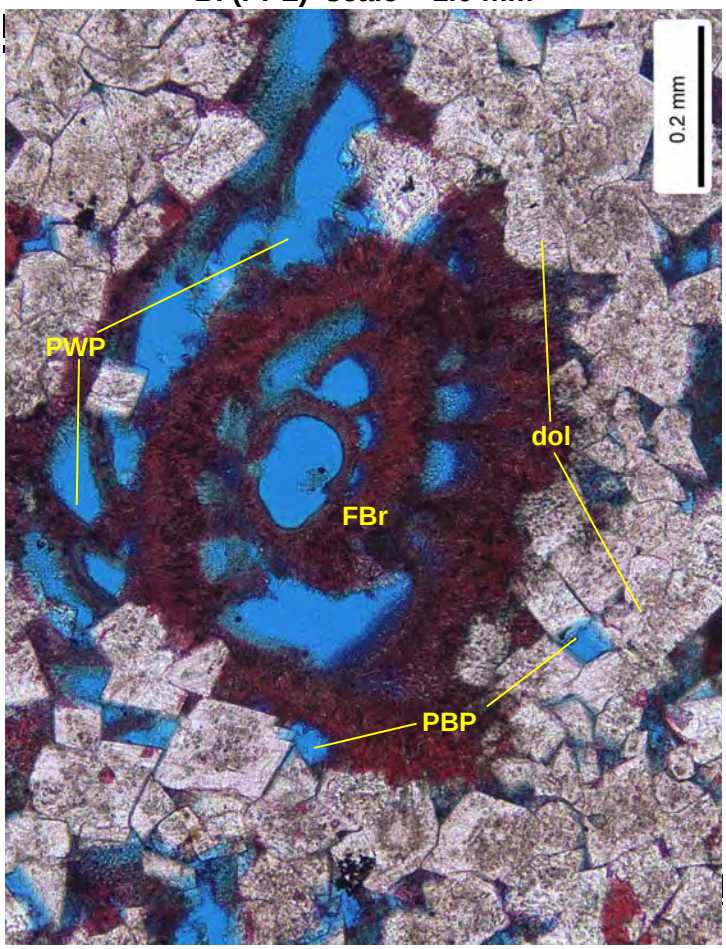
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 12A-12C

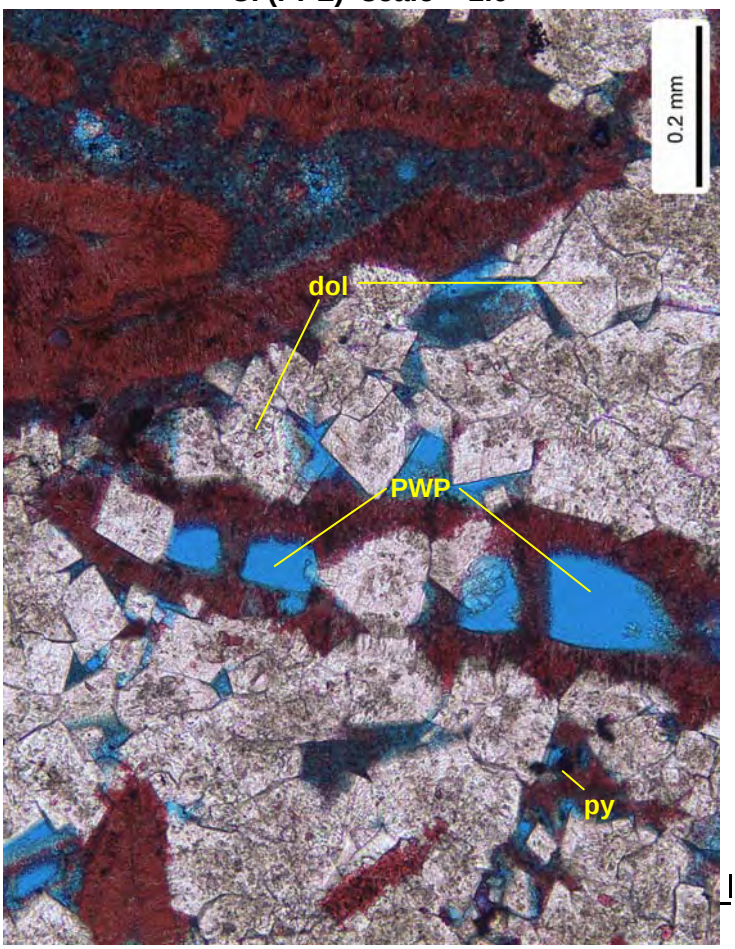


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 13A-13C

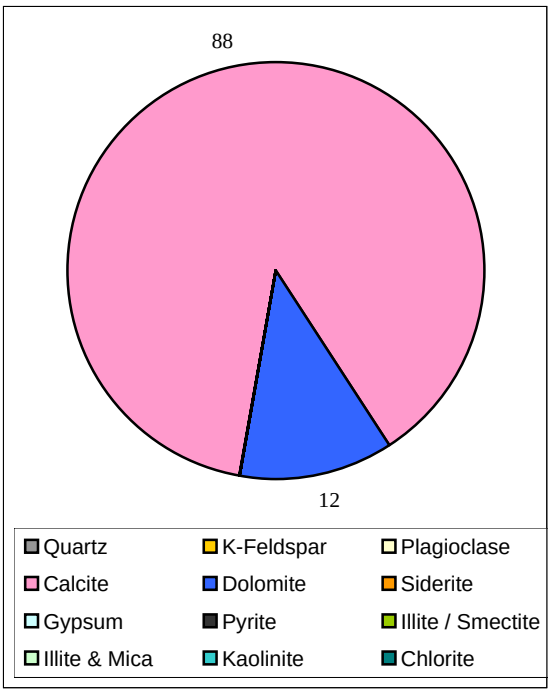
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2111.85

Primary between particle pores (PBP) in this dolomitic bioclast packstone/wackestone due to the high matrix content; primary within particle pores (PWP; mostly within benthic foramnifera) are minor in abundance. Secondary pores are generally rare and isolated. Overall, macropores are moderate in abundance. Bioclasts include benthic foraminifera (miliolids and rotalids (FBr), bryozoans, mollusks, planktonic foraminifera and echinoderms. Other allochemical grains include intraclasts and peloids. Early pyrite (py) cement is often associated with skeletal grains; dolomite (dol) has replaced portions of allochemical grains and matrix, in addition to filling primary pores.

Mineralogy Determined by X-Ray Diffraction (Weight %)



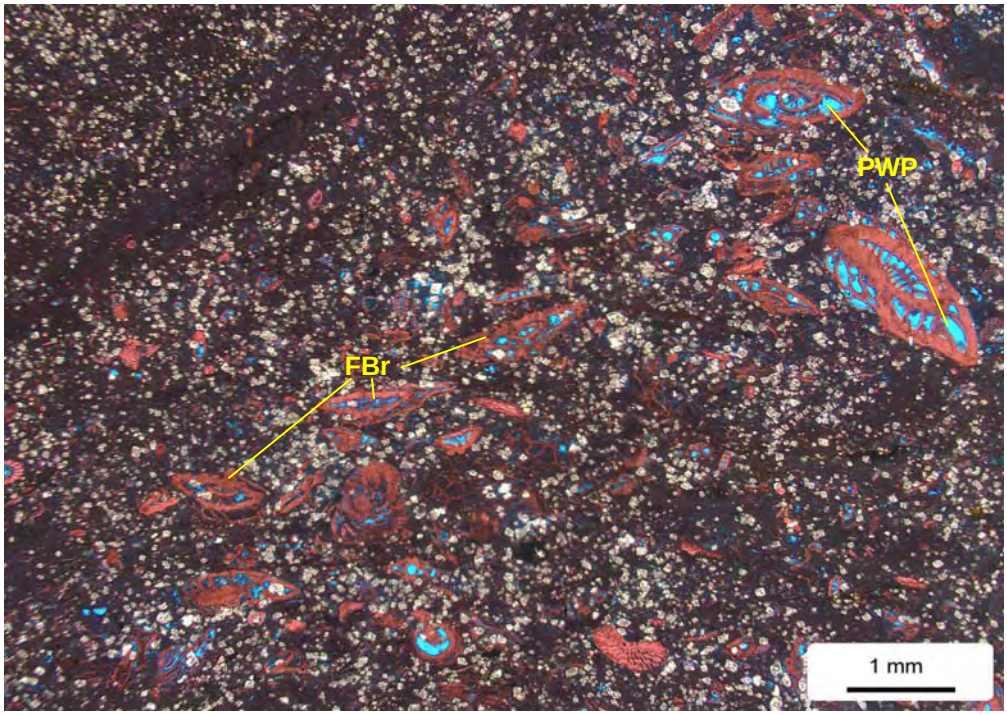
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	88	Total Clay	0
Dolomite	12		

Clay Abundance (Weight %)

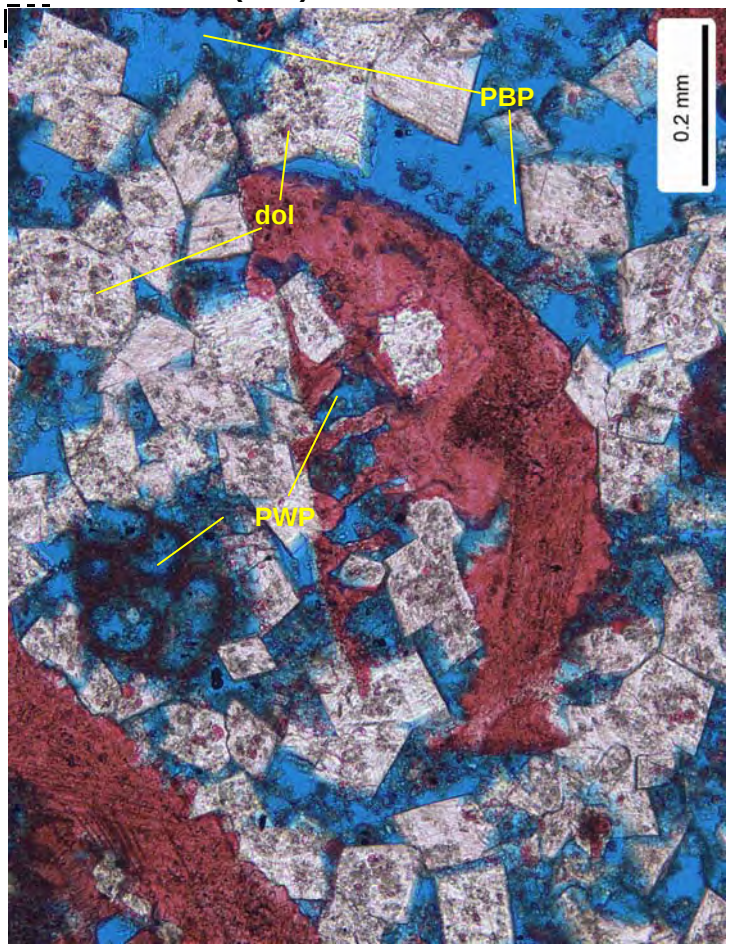
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 13A-13C

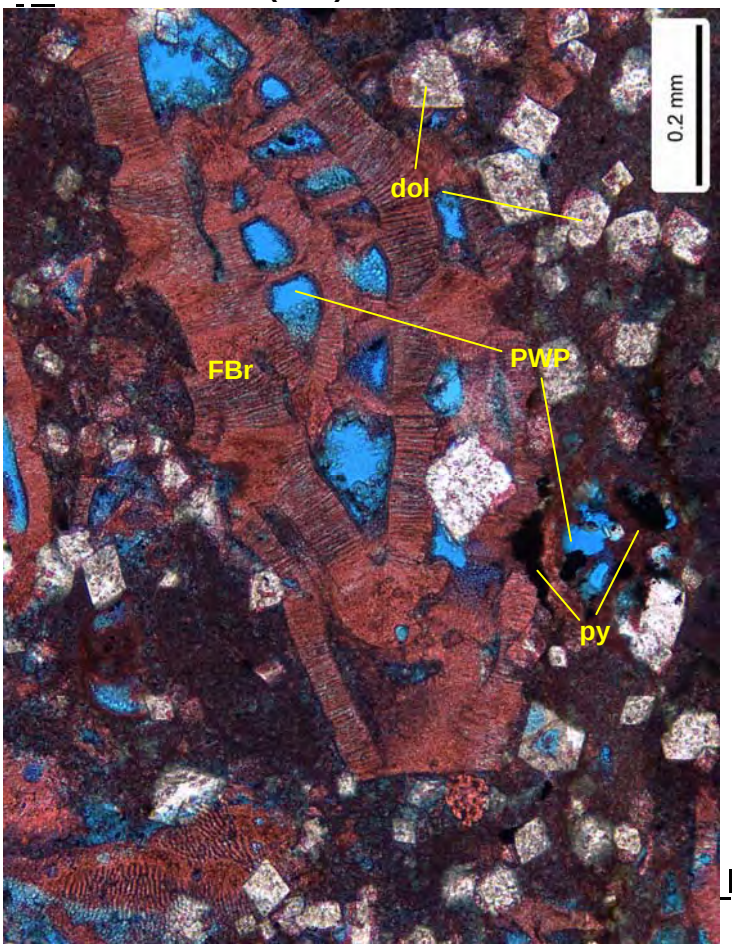


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 14A-14C

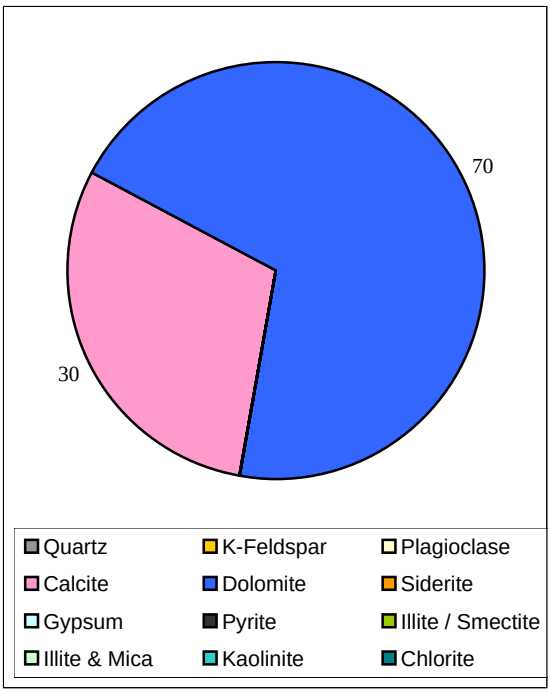
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2113.1

This bioclast peloid dolopackstone/dolowackestone most of the allochemical grains and matrix were replaced by dolomite (dol). Early pore-fringing cement (cal1) and later syntaxial pore-filing cement were either poorly developed or replaced by the dolomite. Both primary between particle pores (PBP) and primary within particle pores (PWP) are rare. Secondary pores are also minor to rare. Overall macropores are minor in this sample, although they may not be well interconnected. Bioclasts include benthic foraminifera (miliolids and rotalids(FBr)), planktonic foraminifera, echinoderms and mollusks.

Mineralogy Determined by X-Ray Diffraction (Weight %)



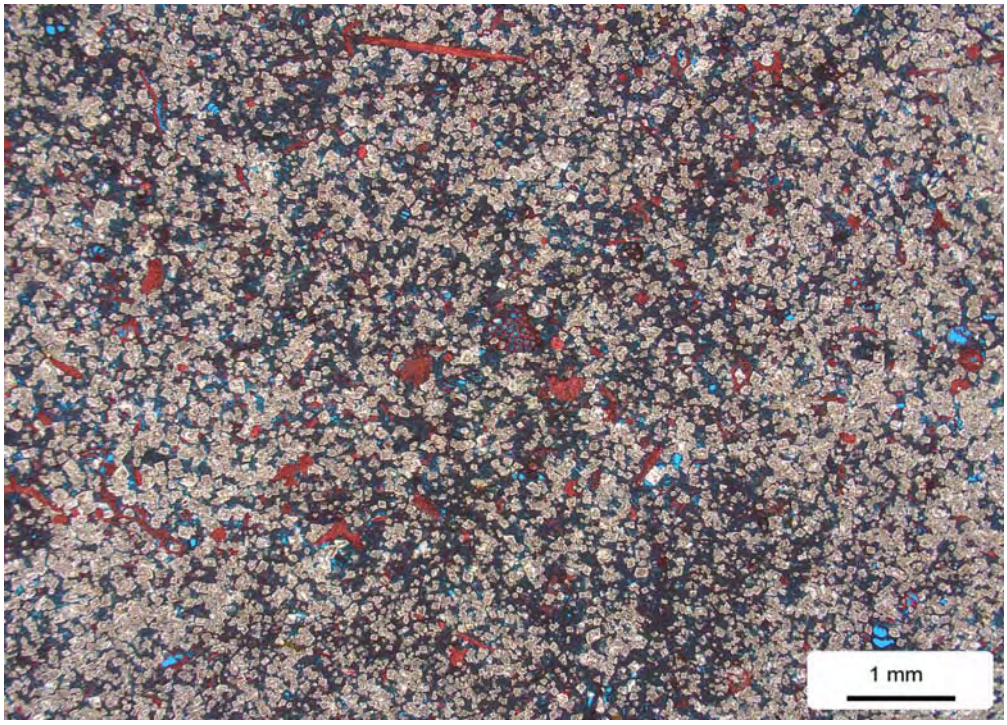
XRD-Whole Rock Mineralogy (Weight %)

Quartz	Tr	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	30	Total Clay	0
Dolomite	70		

Clay Abundance (Weight %)

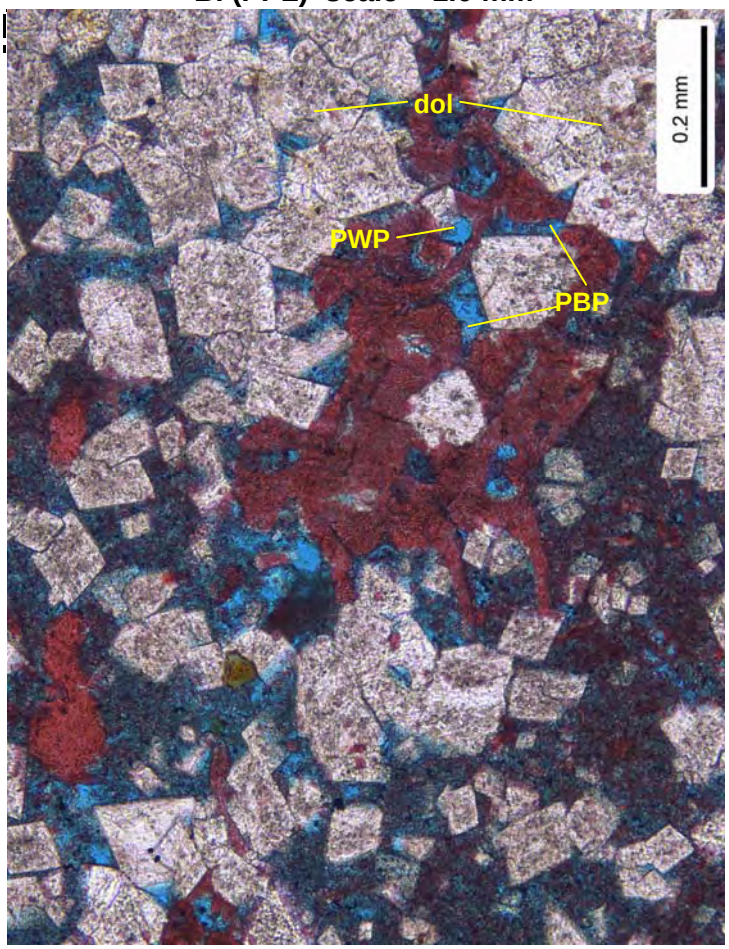
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 14A-14C

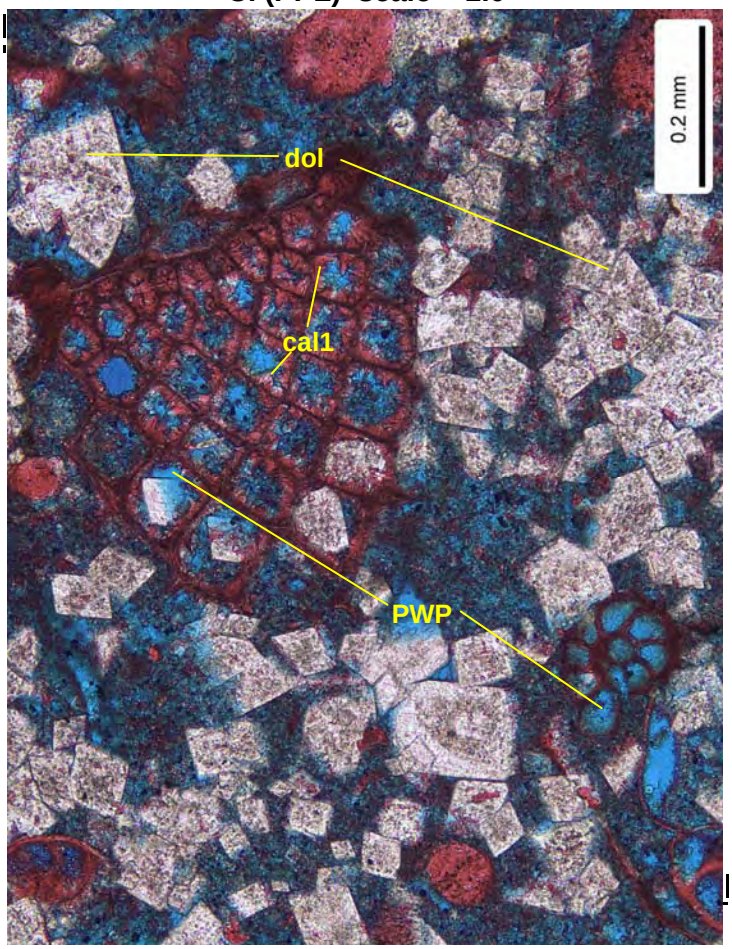


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm



C. (PPL) scale = 1.0



South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

PLATE 15A-15C

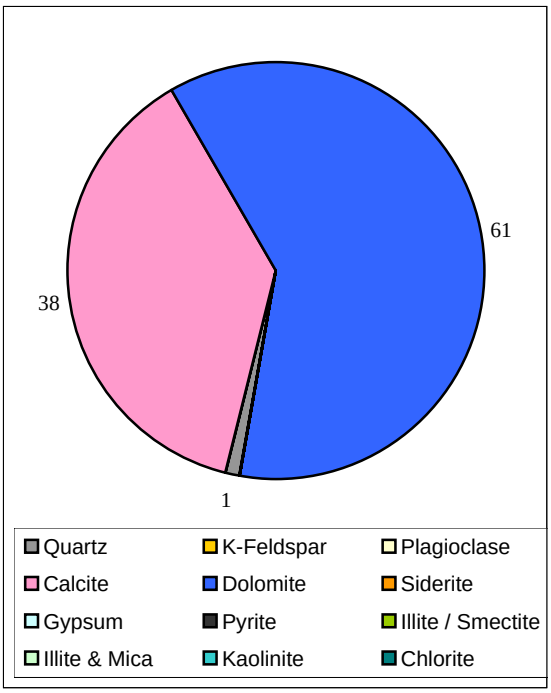
South Florida Water Management District

Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

Depth (ft): 2114.7

This bioclast dolopackstone/dolowackestone contains only moderate amounts of macropores; the abundant micrite matrix and the lack of significant secondary pores are the primary cause of the lower reservoir quality. Primary between particle pores (PBP) and primary within particle pores (PWP) are generally rare and isolated; secondary pores are poorly developed. Bioclasts include bryozoans (bry), echinoderms (ech) and benthic rotalid foraminifera (FBr). Dolomite (dol) has replaced portions of the matrix and filled in primary pores.

Mineralogy Determined by X-Ray Diffraction (Weight %)



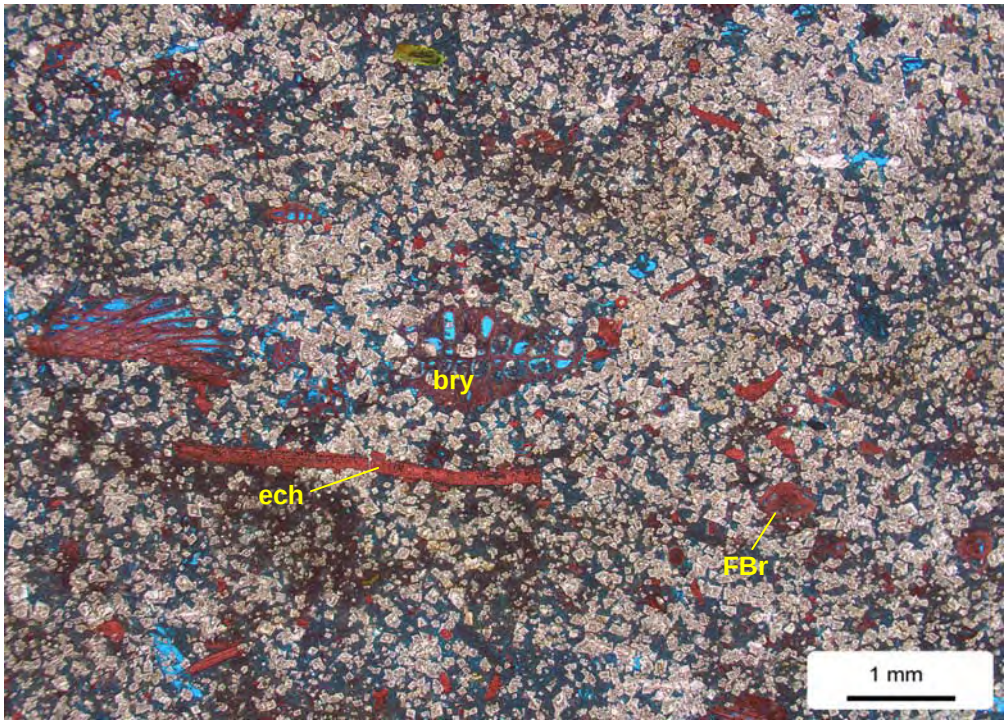
XRD-Whole Rock Mineralogy (Weight %)

Quartz	1	Siderite	0
K-Feldspar	0	Gypsum	0
Plagioclase	0	Pyrite	0
Calcite	38	Total Clay	0
Dolomite	61		

Clay Abundance (Weight %)

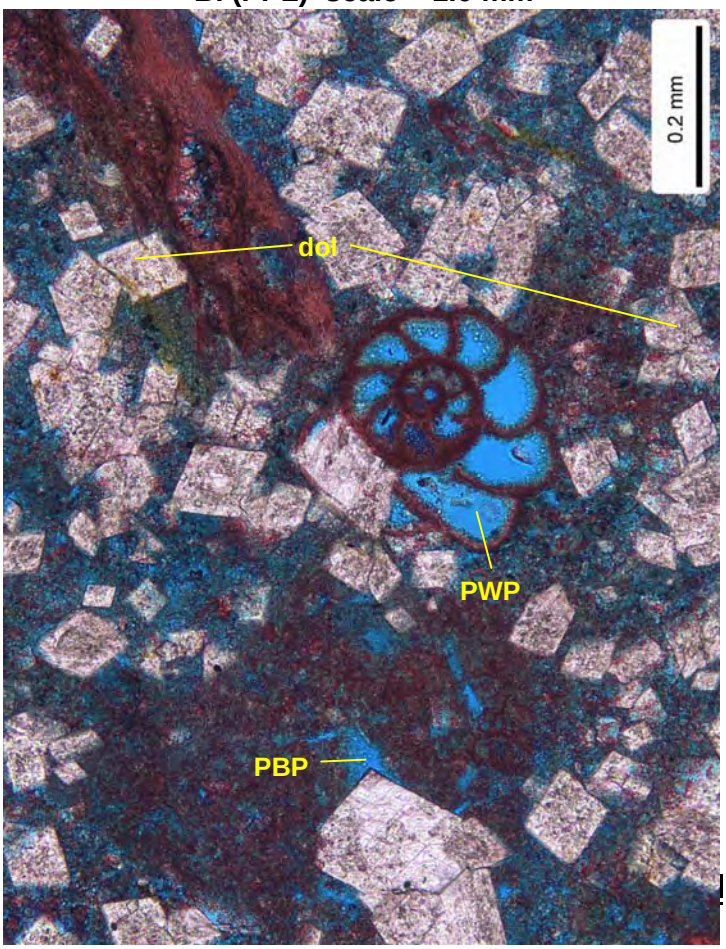
Illite / Smect	0	Kaolinite	0
Illite & Mica	0	Chlorite	0

PLATE 15A-15C

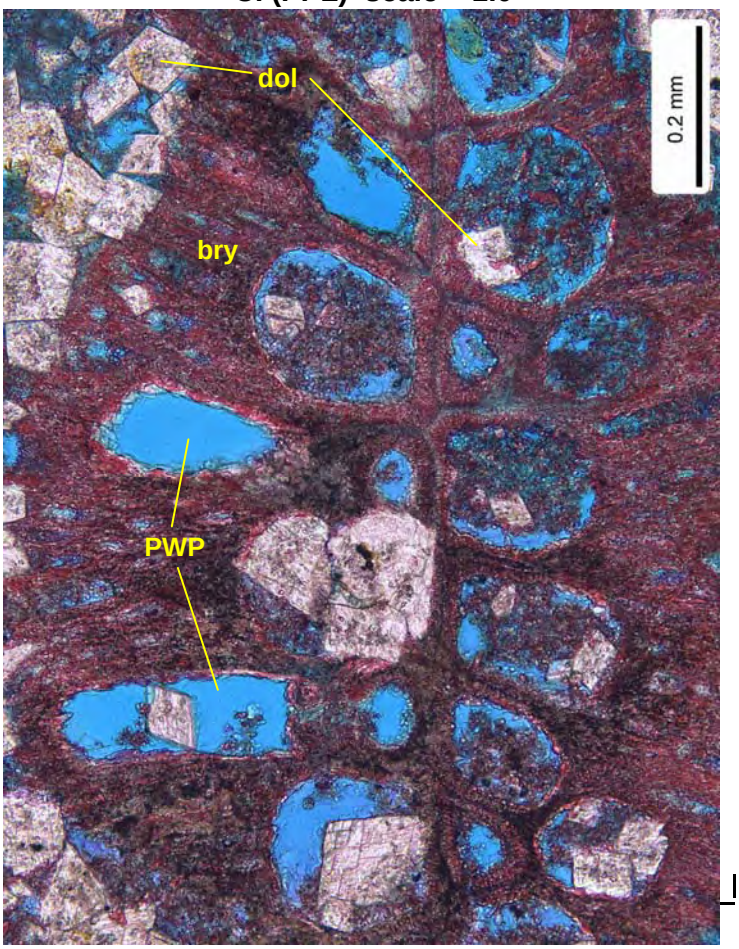


A. (PPL) scale = 1.0 mm

B. (PPL) scale = 1.0 mm

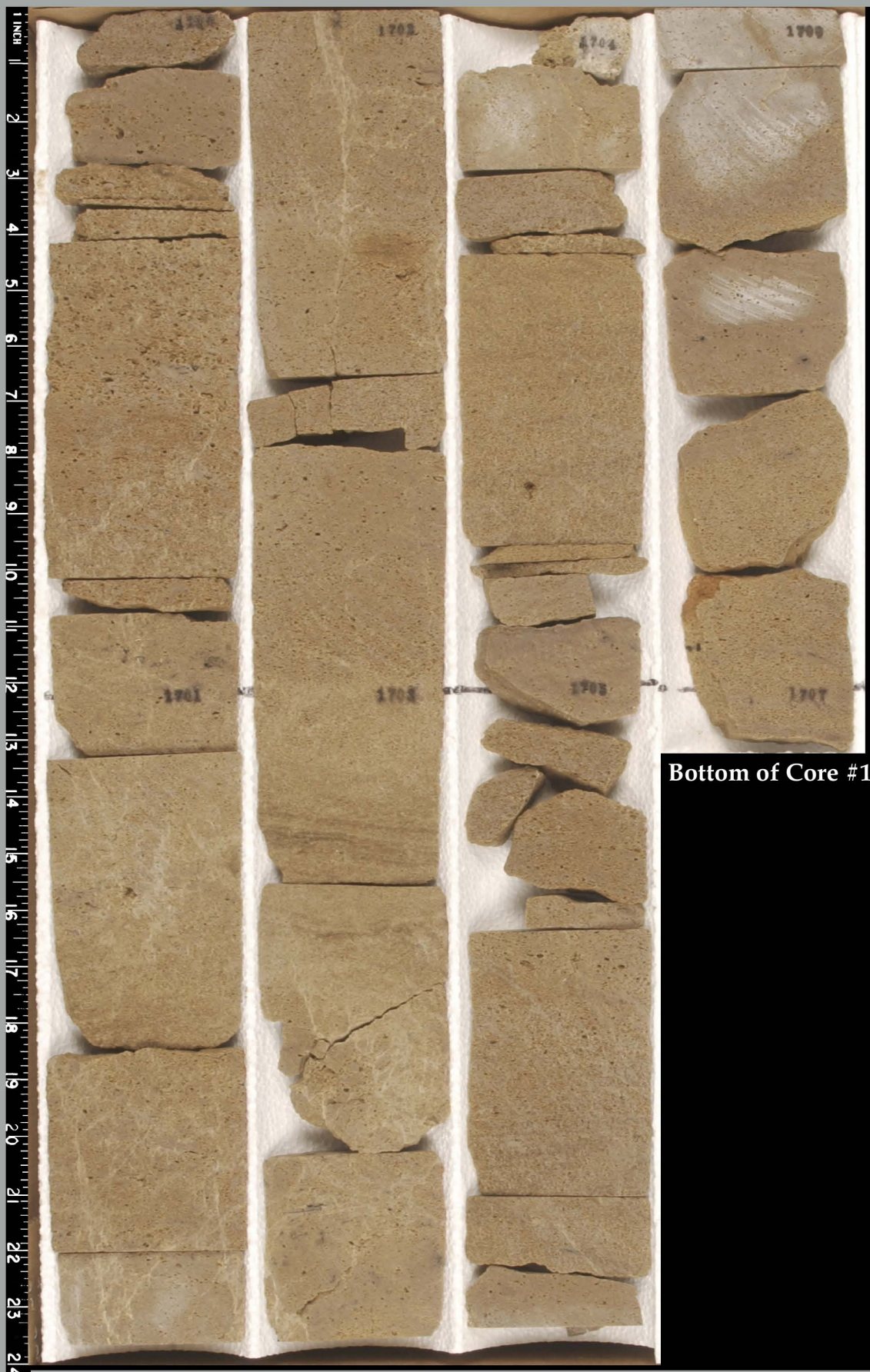


C. (PPL) scale = 1.0



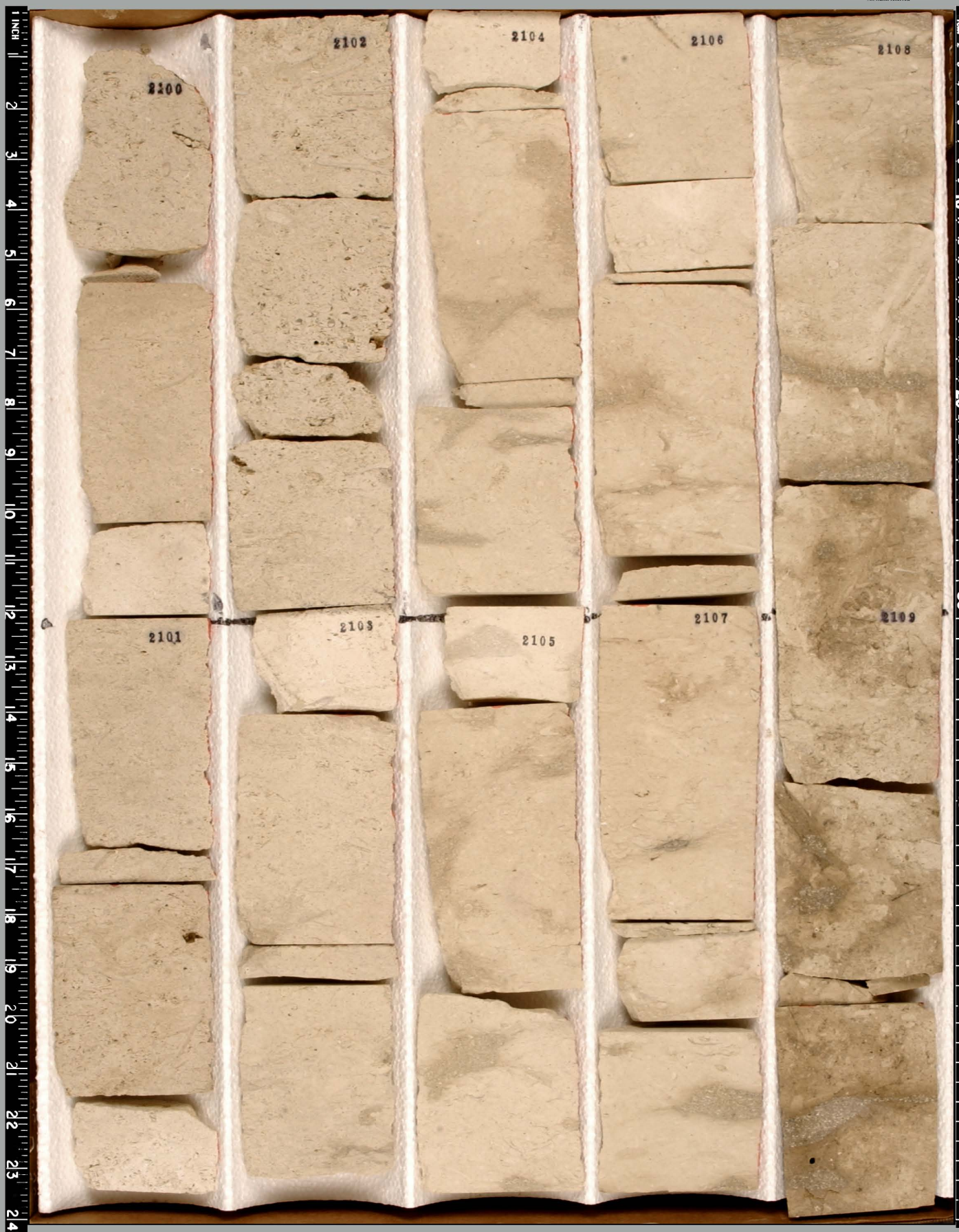
South Florida Water Management District
Well: OKF-105
L. Kissimee Basin, Okeechobee Co., Fla

SOUTH FLORIDA WATER MNGT.
OKF 150
1700 to 1707.15 ft.

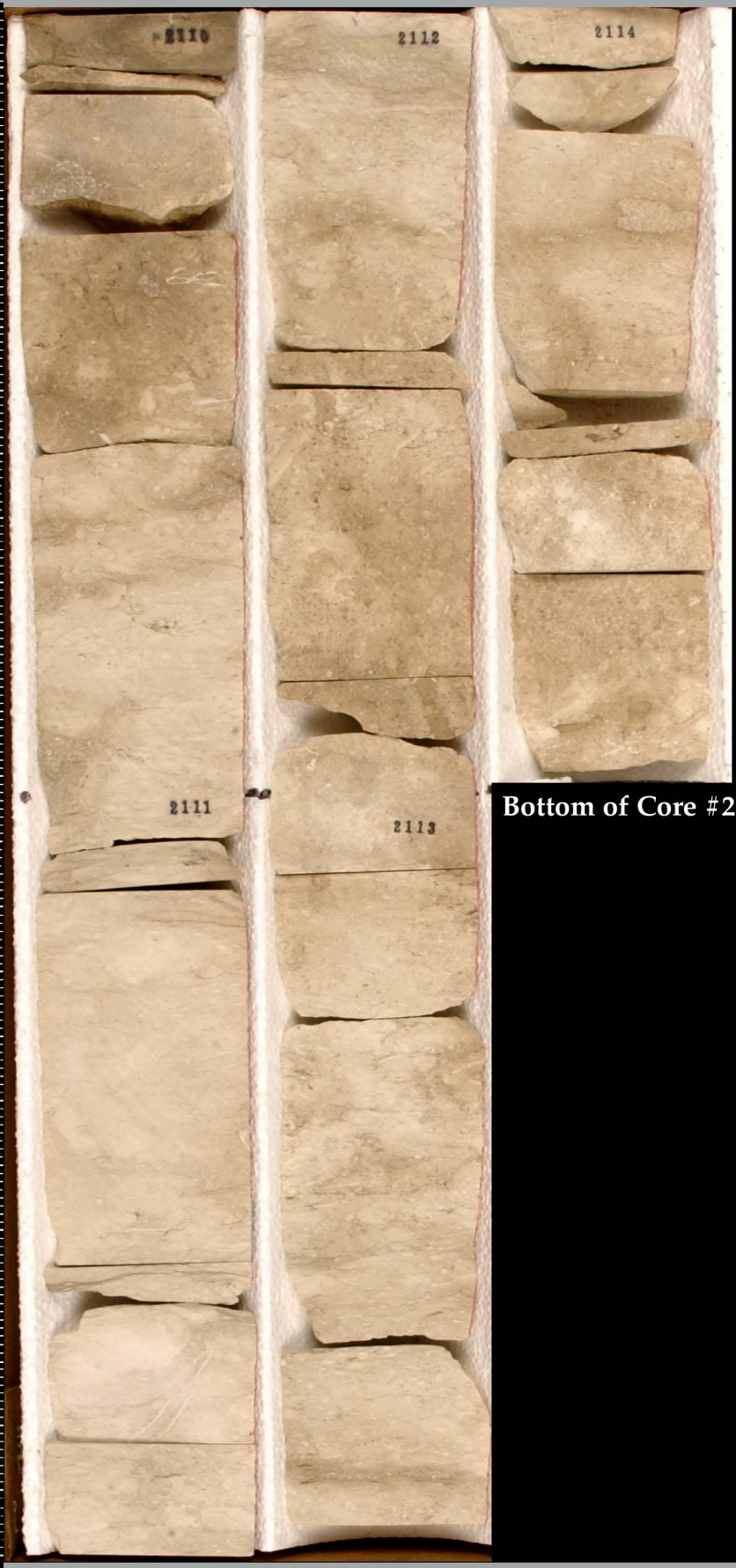


Bottom of Core #1

SOUTH FLORIDA WATER MNGT.
OKF 150
2100 to 2110 ft.



SOUTH FLORIDA WATER MNGT.
OKF 150
2110 to 2115 ft.



Bottom of Core #2