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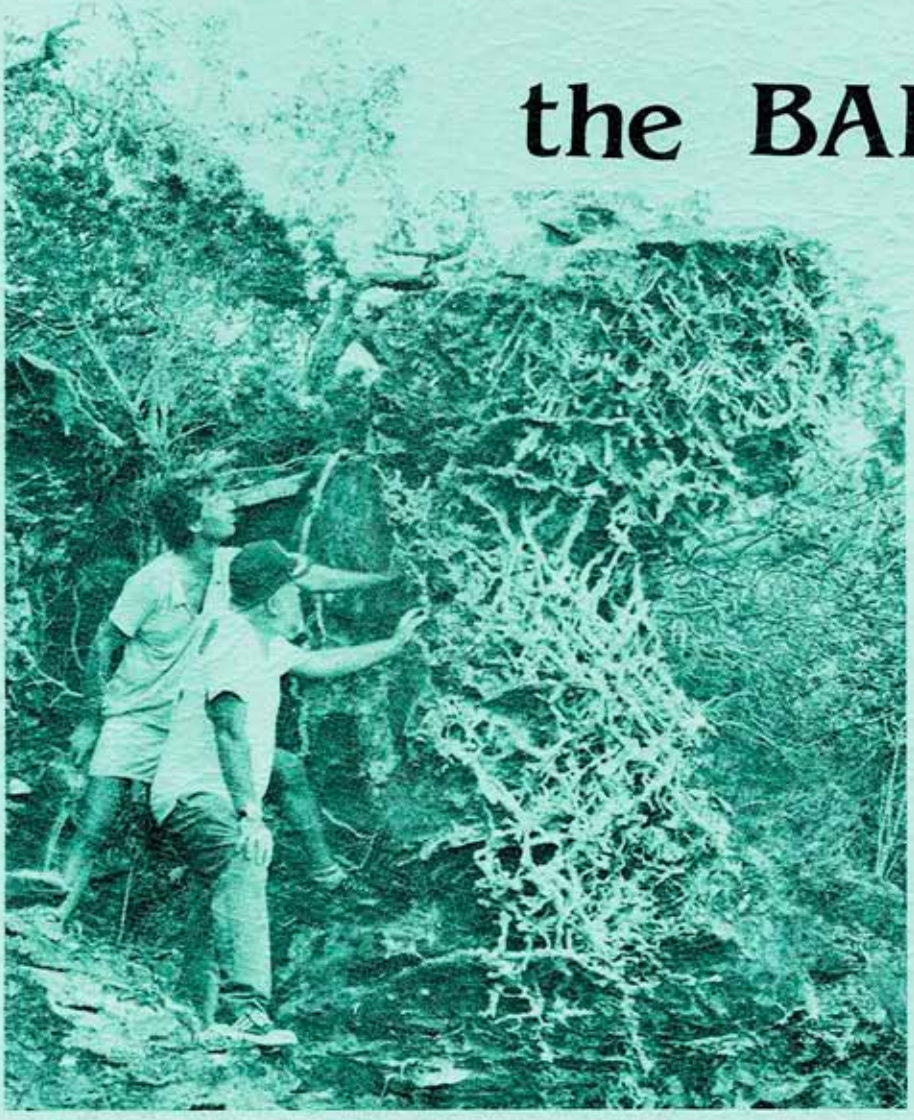

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# ENVIRONMENT OF DEPOSITION OF THE GRANNY LAKE OOLITE, SAN SALVADOR, BAHAMAS

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## Abstract

The Granny Lake Oolite is widely distributed throughout the lake basin, and several facies including nearshore marine, beach, and dune have been recognized. Ooids are believed to have formed during Sangamon Interglacial Stage when sea level was higher, creating a large shallow shelf with a high degree of water agitation. Currents transported ooids on shore, forming beach deposits. Later, ooids were blown into beach dunes. As sea level dropped, the generation of ooids ceased, and the Granny Lake basin became a restricted inland area.

A marine molluscan fauna, Chione cancellata, Strombus, and others is found along the north shore. Whole shells are most abundant in the northeastern portion of the lake basin, near the present day shore, and continuing up the ridge to about 4 feet above present lake level. A zone of bubble porosity occurs approximately 5 feet above lake level indicating intertidal deposition. The oolite is found throughout the basin, except in the southeastern area where the rock contains more bioclastic material. Petrographic analyses of various samples throughout the study area reveal a fresh water cement and varying proportions of bioclastic debris. Foraminifera, molluscan shells and shell fragments, green algae (Halimeda), and course grained ooids are seen in samples collected at elevations ranging from below lake level to about 4 feet above.

Evidence for the beach ridges or dunes can be seen in the modern low-lying ridges (5-60 ft.) to the north of Granny Lake trending east-west, and the higher elevation ridges (120 ft.) along the west shore. Dune cross bedding indicates transport from east to west. The oolite is finer-grained, well sorted and lacks fossil fragments above a 5-foot elevation. These higher beds are cross-bedded and, in some areas, actual dune forms are preserved. Several points of rock extending into the lake on the west shore are lobes of the stoss side of dunes.

## Introduction

The Granny Lake basin is located on the east-central portion of San Salvador, Bahamas, approximately 1.5 miles inland from the Atlantic coast (see index map of San Salvador). The basin is approximately 3 miles long, 0.75 miles wide and is

presently occupied by hypersaline water having a maximum depth of 10 feet. Ridges up to 120 feet high border the lake to the north and west. Lower ridges (40 feet) are present to the east and southeast and form the margins of the basin.

The ridge bordering the west side of the basin trends N-S and has a maximum elevation of 120 ft. Cross bedding indicates transport from the east and several dune-forms are preserved. The north shore is bordered by an E-W trending ridge that is only 5-10 feet in elevation along most of the shore, however it reaches an elevation of 40 feet at the northeastern portion of the basin. A discontinuous NE-SW trending ridge is located south of Granny Lake. It also reaches a maximum elevation of 40 feet.

Detailed mapping (Figure 1) and petrographic study show an areal distribution of four distinct facies: 1) oosparite, 2) biopeloosparite, 3) biooopelsparudite, and 4) biomicrite (Figure 2). In general, the facies grade from ooid-dominated to bioclastic-dominated from northwest to southeast. Changes in sea level during Pleistocene glaciation are responsbile for the generation of ooids and the environmental conditions that produced these facies.

## Petrography of Facies

Oosparite: The oosparite facies is composed of a fine-grained, well sorted oolite (Figure 3a). Ooids make up approximately 90% of the rock along with 10% pellets and less than 1% coated bioclasts. Ooids range from 0.1 to 0.3 mm. Fossil material is generally absent in samples collected from

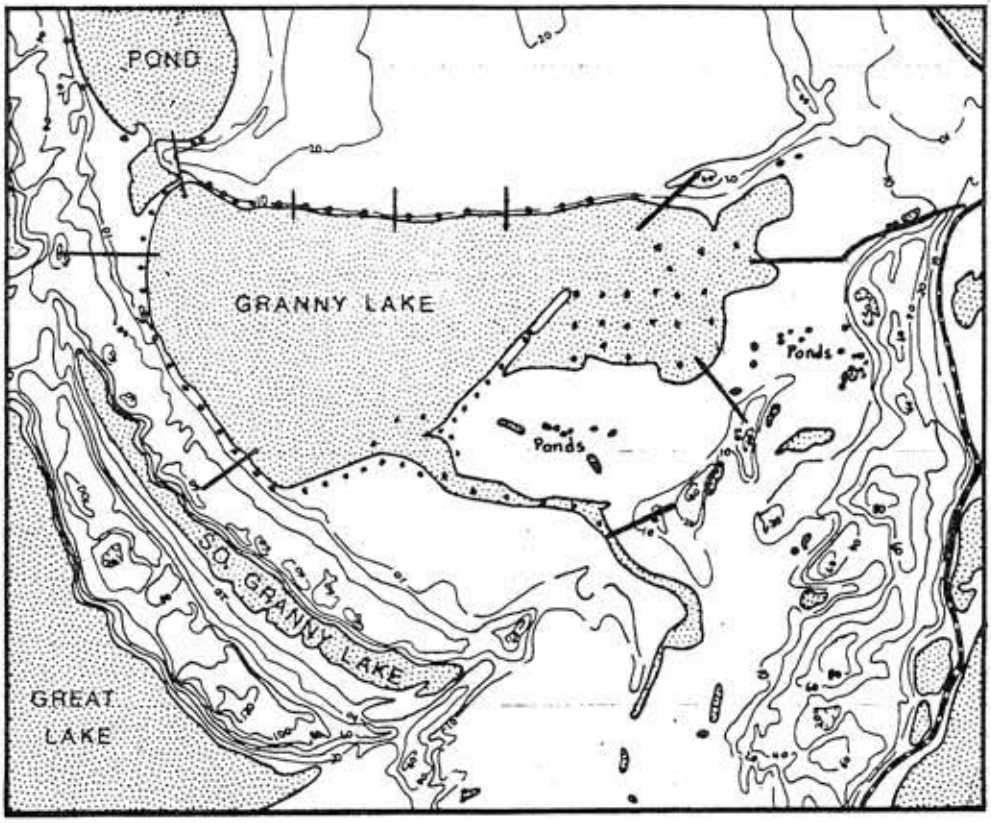



Figure 1: Map of Granny Lake Basin. Dots indicate sample areas. Bold lines indicate lines of traverse. Map dimensions: 3 miles E-W, 2.5 miles N-S, North at top of map.

locations greater than 15 feet above present lake level of Granny Lake. Foraminifera are common in strata between 4 feet and 15 feet above lake level.

Oosparite occurs on the north and west ridges at elevations 4 feet above present lake level (Figure 2). On the north ridge, at this elevation, there appears to be a zone of bubble porosity. On the west ridge, a bubble porosity zone occurs approximately 15 feet above present lake level. Bubble porosity zones are currently forming along beach faces, such as Grahams Harbour and Grotto Beach, in the swash zone on a falling tide. Bubble porosity may also be referred to as birdseye vugs (Shinn, 1968). This zone marks an ancient shoreline when sea

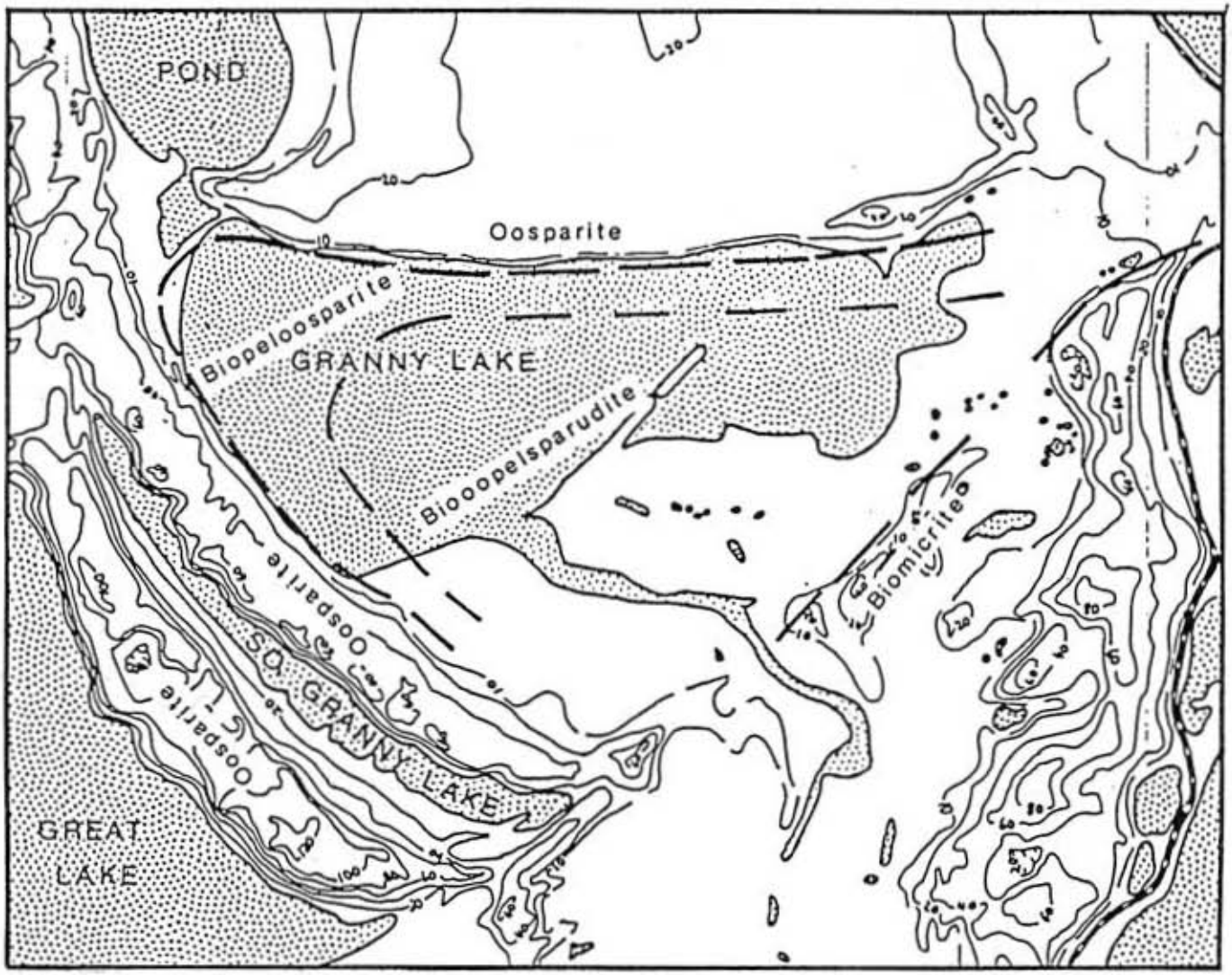



Figure 2: Facies Map of Granny Lake Basin. Note: oolite on north and west ridges, biopeloosparite disappearing into the lake to the southeast, biooopelsparudite southeast of lake disappearing into the lake to the northwest, and biomicrite on southeast and east ridges. Map Dimensions: 3 miles E-W, 2.5 miles N-S. North at top of map.

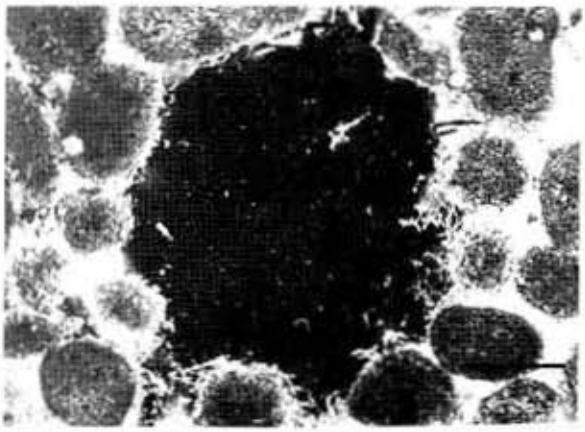
level was higher, perhaps during the Sangamon Interglacial Stage.

Cross bedding is a prominant feature on the west ridge. The ridge is composed of a series of dune-forms having low angle cross beds facing east representing the stoss side, and high angle cross beds facing west representing the lee side of the dunes. At several locations, especially in the southwest portion of the Granny Lake shoreline, lobes of these preserved dunes extend beyond the shoreline into the lake.

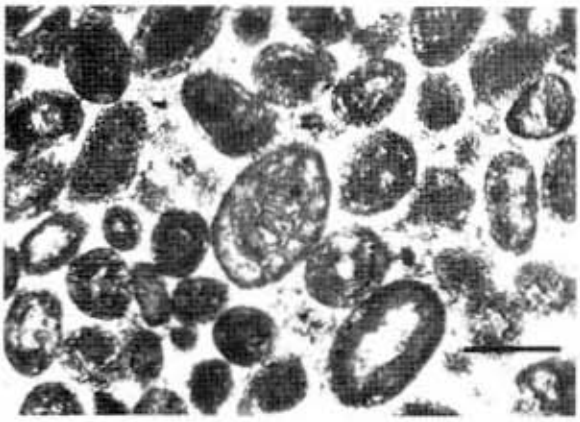
Biopeloosparite: The biopeloosparite facies consists of a fine to medium-grained, medium sorted oolite (Figure 3b). Ooids comprise approximately 70% of the rock along with 25-30% pellets and less than 5% bioclastic material (Foraminifera, Halimeda, pelecypods, and red algal fragments). Grains range in size from 0.1 to 0.8 mm, excluding large Chione shells.

This facies occurs along the northwest area of the Granny Lake basin, less than 4 feet above present lake level to an unknown depth within Granny Lake (Figure 2). Toward the east it contains more shell material. In some samples well preserved, single valves of Chione cancellata are quite abundant.

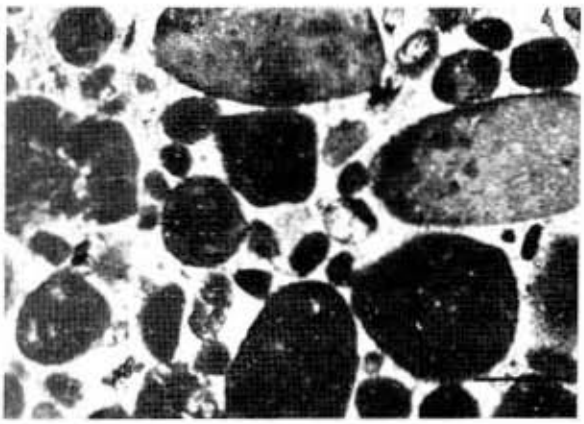
Biooopelsparudite: The biooopelsparudite facies is composed of a mixture of large pellets (60%), ooids (30%), and large bioclastic material (10%) (Figure 3c). It is medium to coarse-grained and poorly sorted. Grains of matrix range in size from 0.07 mm to greater than 7.0 mm. Most of the bioclastic material consist of large, whole single valves of pelecypods (Chione cancellata) and gastropods (Bulla), along with Foraminifera, Halimeda, and red algal fragments.



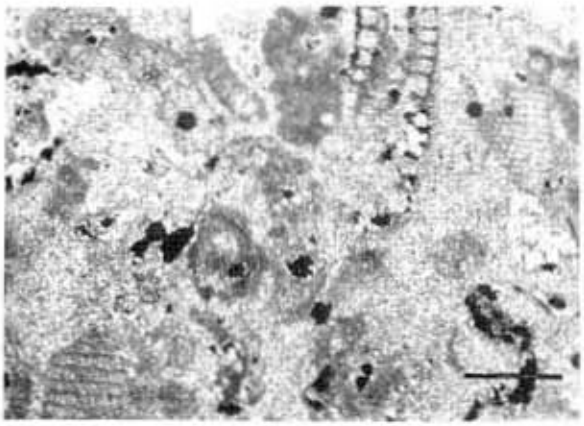
a) Oosparite displaying bubble porosity (Birdseye vug). Grains are micritized ooids surrounded by sparry calcite cement. (Bar scale = 0.3 mm)



b) Biopeloosparite. Grains are micritized ooids and pellets with Foraminifera in center of photomicrograph surrounded by sparry calcite cement. (Bar scale = 0.3 mm)



c) Biooopelsparudite. Grains are micritic pellets surrounded by sparry calcite cement. Ooids and large bioclasts are absent in this photomicrograph. (Bar scale = 0.3 mm)



d) Biomicrite. Bioclastic material includes red algae (lower left corner) and Foraminifera (upper right corner) within a micrite matrix. (Bar scale = 0.3 mm).

Figure 3: Photomicrographs representing distinct facies.

Biooopelsparudite occurs along the east and south shores of Granny Lake and extends in toward the center of the lake for an undetermined distance (Figure 2).

Biomicrite: The biomicrite facies is composed of 10-15% Foraminifera, 5-10% pelecypods, and 5% red algal fragments in a 60-70% micrite matrix (Figure 3d). The bioclastic material ranges from 0.1 mm to 5.0 mm.

Biomicrite comprises most of the discontiuous ridge to the south of Granny Lake from approximately 5 feet above present lake level, and Little Fortune Hill which is part of the ridge along the east side of San Salvador. Beneath this 5 foot level lies the biooopelsparudite.

## Environments of Depostion

The oosparite represents beach and dunes as indicated by dune-forms, high degree of sorting, absence of coarse bioclastic material, and position above the zone of bubble porosity. Biopeloosparite, which rests at elevations lower than oosparite and below the zone of bubble porosity was deposited in lower beach and subtidal, restricted shallow water environments as indicated by the dominance of ooids intermixed with pellet and bioclastic material. Toward the southeast the ooid-dominated environments are replaced by more marine environments which produced the biooopelsparudite and biomicrite facies.

The ooids were generated between the bioclastic material in the southeast and the dunes in the northwest, then were moved onto the beach and dunes. The area of ooid generation was part

of the shallow shelf, however depth alone is not sufficient to explain the distribution of oolite. Along the east and west coasts of Andros and along the west coast of Bimini, there are extensive shoal water bottom deposits that contain few or no ooids. Bottom agitation is another basic requirement in ooid formation (Purdy and Imbrie, 1964). Therefore, normal, shallow marine conditions, with sufficient bottom agitation, once existed in the Granny Lake basin.

## Summary

The Granny Lake basin is a lowland area bordered by a series of ridges to the north and west adjacent to the present shoreline. A discontinuous ridge trending NE-SW is located southeast of Granny Lake.

The basin is composed of four facies which were deposited during a higher stand in sea level, perhaps during the Sangamon Interglacial Stage. At that time sea level was approximately at a 4 foot elevation above present lake level. Oosparite was deposited in the beach and dune environment and is preserved in the north and west ridges surrounding the Granny Lake basin. Biopeloosparite was deposited in the lower beach, subtidal zone and occurs at the base of the north and west ridge and disappers to the southeast into the lake. The biooopelsparudite was deposited in a nearly open marine environment and is located in the southern portion of the Granny Lake basin and disappears to the northwest into the lake. The biomicrite was probably deposited at a later time during a higher stand in sea level

which produced the discontinuous ridge southeast of Granny Lake and the ridge along the east side of San Salvador. The micrite which comprises these ridges may have formed by the breakdown of bioclastic material instead of depositional processes.

Generation of ooids occurred during a high stand in sea level when most of San Salvador was flooded. This created a large, shallow shelf extending into the Granny Lake Basin. Ooids are not forming today along San Salvador because the drop in sea level eliminated the broad, shallow (restricted) shelf required for ooid generation.

# REFERENCES

Purdy, E. G. and Imbrie, J., 1964, Carbonate sediments, Great Bahama Bank, Guidebook for Field Trip No. 2, Geol. Soc., Convention 1964: New York, Geol-Soc. Am., 66 p.

Shinn, E. A., 1968, Practical significance of birdseye structures in carbonate rocks: Jour. Sed. Petrology, v. 38, p. 215-223.