The Sequence of Holocene Sediments, Joulters Cays Area*

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Joulters Cays Area

GUIDEBOOK

FOR

MODERN BAHAMIAN PLATFORM ENVIRONMENTS

Second Edition

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involves: 1) #1)-3) as for the vadose zone, but with more intensive dissolution, including wholesale removal of aragonitic skeletal fragments; 2) recrystallization of marine isopachous aragonitic needle cements to elongate calcite scalenahedra (10 x 100 μ) which have a radial isopachous fabric around the ooids. Cementation in the upper portions of the phreatic zone is characterized by: 1) 10-30% low Mg calcite; 2) 10-50 μ diameter clear, equant calcite spar cement; 3) "dog-tooth" isopachous cement fabrics, formed by multiple sparry crystals; 4) progressive pore filling with an increase in crystal size toward the pore center and abundant enfacial angles.

The Joulters rocks indicate the extreme rapidity with which fresh water diagenesis may occur: the oldest dunes (less than 1800 years) have 20-30% low Mg calcite; the youngest dunes (probably less than 100 years) already have 5-9% low Mg calcite.

Geometry of the Joulters Complex.

The following section has been provided by P.M. Harris, who is presently completing a detailed study of the sedimentology and stratigraphy of the ooid complex north of Andros Island.

The Sequence of Holocene Sediments

Joulters Cays Area*

Introduction

This investigation focuses on the sequence of sediments generated during the Holocene rise in sea level in the Joulters Cays area, north of Andros Island.

The Joulters Cays ooid sand complex consists of several interrelated, but unique depositional environments. Sediment cores have been taken in the different depositional environments using a manually-operated pile-driver corer, a gasoline-powered vibrocorer, and a gasoline-powered jack-hammer corer. Probes of sediment thickness have been made using a 3/8 inch diameter stainless steel rod. The locations of sediment cores and probes are indicated in Figure 28A. Total core recovery for the 53 core locations is 110 meters. Data from 10 cores and sediment thickness measurements from an additional 21 probe locations were used in constructing Cross Section A - A' (see Fig. 28A for cross section location). Conclusions in this report are based primarily on this cross section.

Conclusions

Tentative conclusions are:

a. Only a thin veneer of skeletal grainstone has accumulated on the platform margin shelf seaward of the Joulters Cays and marginal sand shoal.

* PhD research in progress at the Comparative Sedimentology Laboratory, University of Miami, Fisher Island Station

b. Sediments of the innermost shelf (just seaward of the marginal sand shoal) are a mixed skeletal and ooid - peloid grainstone approximately 1 m thick.

c. The marginal sand shoal is an approximately 5 m thick accumulation of ooid grainstone. Deposition was in part controlled by pre-existing topography.

d. The Joulters Cays are a part of the marginal sand shoal that was cemented by meteoric waters during the Late Holocene.

e. The muddy sand flat [protected mud flat] is a 1-2 m thick accumulation of foraminifera - peloid - ooid packstone to wackestone overlying the bankward edge of the Joulters Cays and a few other islands.

f. The stabilized sand flat is a 4-7 m thick accumulation of upward coarsening sediments that interfingers with the marginal sand shoal and muddy sand flat to the east and gradually changes into platform interior sediments to the west. A basal pellet wackestone is overlain by a fine sand and silt - peloid packstone which is overlain by a peloid - ooid packstone. Burrowing is common throughout the sequence. Sedimentation was in part controlled by pre-existing topography.

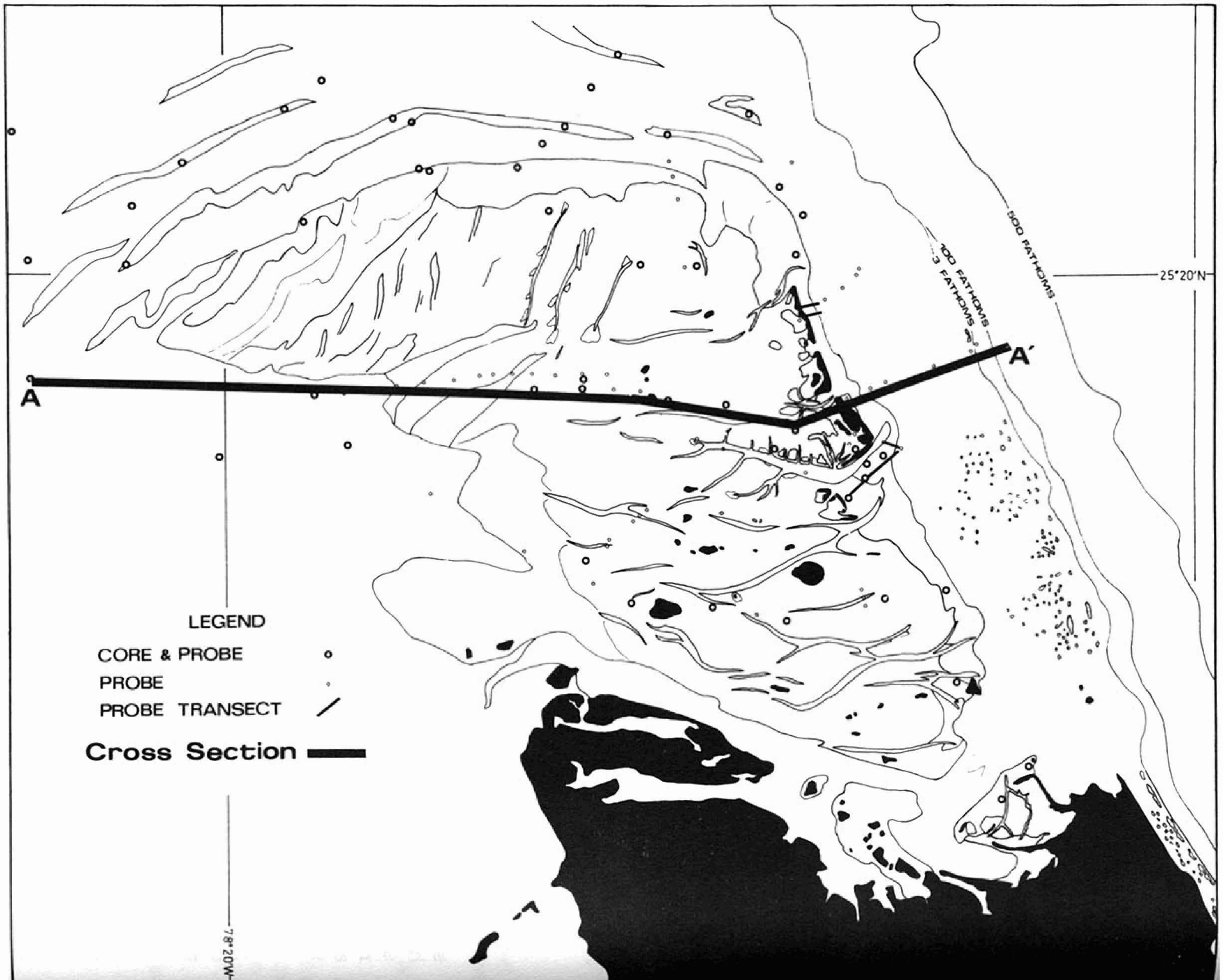
g. The platform interior is a 2-3 m thick accumulation of fine sand - pellet packstone to wackestone.

Discussion

The pre-existing (Pleistocene) topography initially influenced sedimentation in the Joulters Cays area. Subsequently, sedimentation has been influenced by the co-evolving Holocene topography (the marginal sand shoal and islands). The sequence of sediments deposited is a result of sediment production during a rising sea level and the interaction of tidal currents, wind- and storm-generated waves, and bottom topography along a platform margin location.

The most change in the vertical profile occurs in the upward coarsening accumulates of the stabilized sand flat. Lateral changes to more ooid rich sediments toward the east are abrupt, while changes to pelleted fine grained sediments toward the west are more gradual. Sediments have accumulated nearly to sea level over a 375 sq. km area. It is probable that much of the sediment was not deposited until ooid formation began. Ooid accumulation into a sand shoal and islands has restricted circulation and the bankward movement of ooids.

Relationships between sediment types in the Holocene sequence are not entirely clear. Further study of sediment cores and additional probing are necessary to answer many intriguing questions.



A
A´
500 FATHOMS
100 FATHOMS
3 FATHOMS
25°20'N
78°20'W
LEGEND
CORE & PROBE
PROBE
PROBE TRANSECT
Cross Section

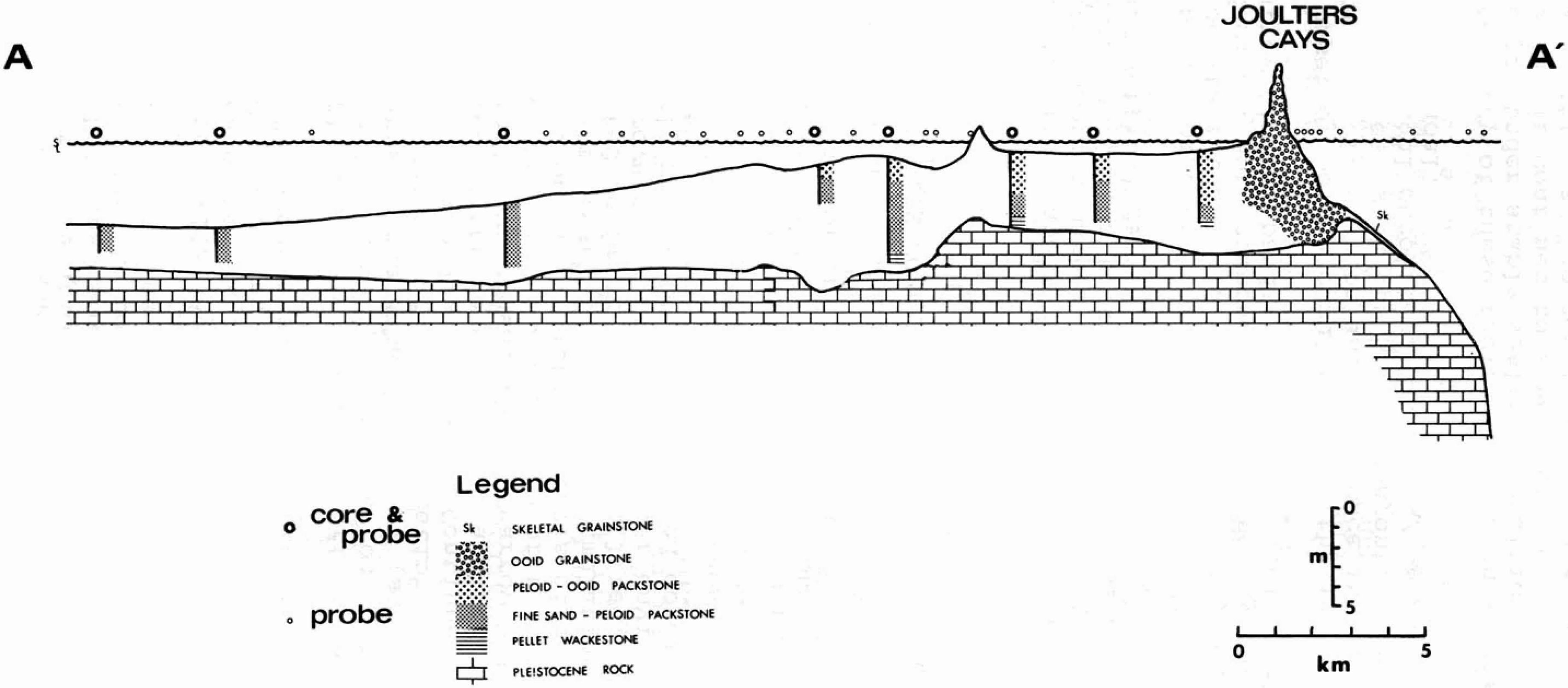


FIGURE 3. CROSS SECTION A - A'

Several important relationships are evident from Harris' study: 1) as in other Holocene marginal ooid deposits (6, 72), pre-existing topography determines the position of the shoal; 2) finer sediments accumulate first in the lee of the Pleistocene marginal rim and then continue to accumulate in the lee of the Holocene ooid sand shoal; 3) contrary to an earlier hypothesis (first edition of this book), the ooid grainstones do not extend platformward under the stabilized sand flat (i.e. ooid grainstones did not form an early Holocene sheet deposit on the Pleistocene surface in this area).

The raised Pleistocene marginal lip effectively prevented Holocene ooid grainstones from developing further onto the platform, as they did in other parts of the Bahama platform (see below). Conditions of high turbulence, required for ooid formation, have been confined to the marginal rim in the Joulters area. Continued, slow sealevel rise has resulted in the development of a thick, linear shoal. Continued vertical development along a narrow belt has resulted in island formation near the landward edge of the shoal. As the shoal continues to develop, it greatly restricts circulation and wave energy to the west, resulting in the accumulation of finer grained, more poorly sorted sediments of the stabilized sand flats. Storms and hurricanes move ooids into this latter environment, but biologic processes quickly rework the storm-derived ooids into the finer grained sediment.

The coarsening upward of stabilized sand flat sediments implies an increased supply of ooids to this environment during the late Holocene. The cause for this increased supply is not clear at present.

OOLITE COMPLEX : IMPORTANCE OF FACIES RELATIONSHIPS AND SEALEVEL HISTORY

As in the reef-lagoon complex, the development of the oolite shoal brings about a marked change in associated depositional environments, and leads to the development of a predictable lateral and vertical facies sequence.

The basic components of this system are the oolite shoal (Purdy's oolite facies) and the bankward muddy oolite (Purdy's oolitic facies). Both components are presently developed in relatively narrow, linear bands, roughly parallel to the bank margin.

The onset of ooid accumulation, in the form of a shoal, greatly reduces circulation and turbulence in bankward areas. Thus, the oolitic facies, with its higher concentrations of fines, organics, burrowing and algal oncolites, invariably is associated with an active oolite shoal.

The geometry of these facies depends on sedimentation-subsidence relationships. Under stable sealevel conditions, as at present, ooid formation is confined to a very narrow band. Accumulation of ooids consequently is also confined to a narrow band, and leads to