



N329: Improved Models for Exploration and Production Scale Heterogeneity on Isolated Carbonate Platforms: Crooked-Acklins Platform (*Southern Bahamas*)

Instructor(s): Gene Rankey

6 Days	Competence Level: Skilled
 Field Course	 Classroom Elements
 HIGH	High Physical Demand

Summary

This field seminar explores carbonate sedimentation, stratigraphy and early diagenesis by examination of Pleistocene and Holocene carbonates of the Crooked-Acklins Platform, southern Bahamas. Participants will make field observations in terms of potential fluid storage and movement (porosity and permeability), reservoir and barrier continuity (compartmentalization) and recovery potential (oil-water relative permeability, connectivity). These will provide useful knowledge for assessment of subsurface carbonate reservoirs.

Learning Outcomes

Participants will learn to:

1. Discern the characteristics of carbonates from different depositional and diagenetic environments, and how they might be recognized in the geologic record.
2. Evaluate the different scales of heterogeneity in these carbonate depositional systems using field and remote sensing observations.
3. Characterize the controls on this heterogeneity, including geological, physical, chemical and biological oceanographic aspects.
4. Integrate these observations into a global (Holocene) and geological (deep-time) perspective.
5. Develop meaningful, predictive conceptual models of reservoir geometry and continuity and possible play relationships in subsurface analogs.

Duration and Training Method

A six-day field course (1 day in the classroom, 5 days in the field). The modern carbonate system will be examined by boat, and will include sampling and snorkeling over specific facies belts representing different depositional conditions. Pleistocene deposits will be examined at outcrop. Evening sessions will review the day's stops and make comparison to ancient carbonate depositional settings around the world. Participants are encouraged to bring examples they may be working on.

Physical Demand

The physical demands for this class are HIGH according to the Nautilus field course grading system. The trip includes physical exertion, and is marked by considerable time in and on the water. This requires that participants be able to swim in some rigorous environments. It will take place in the subtropics in spring-summer, where heat and dehydration are concerns. Transport between stops will be by open boat. Accommodation will be in shared double rooms.

Who Should Attend

This course addresses the fundamental controls on carbonate systems with a global and a deep-time



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reservoir perspective and most concepts are broadly portable, beyond this platform. Thus the course is suitable for geologists, geophysicists, petrophysicists, reservoir engineers and managers assigned to carbonate evaluations.

Prerequisites and Linking Courses

Familiarity with carbonate systems, as presented in N020 (Carbonate Depositional Systems), is assumed. This modern carbonate course is complimented by a number of field courses on ancient carbonates, including N059 (Applied Carbonate Geology: Carbonate Facies and Reservoirs (Mallorca and Menorca, Spain)) and N091 (Carbonate Reservoir Architecture and Applied Carbonate Sequence Stratigraphy (West Texas and SE New Mexico, USA)).

Course Content

The Crooked-Acklins Platform (CAP) is an ideal location for learning many fundamentals of carbonate sedimentary systems. Located between the Great Bahama Bank and the Caicos Platform, the CAP includes all of the “classic” Holocene environments of both areas, including both wave- and tide-influenced sedimentary systems. Importantly, these different environments all occur in close proximity, such that long boat rides are not necessary to see the entire spectrum of environments. Instead, participants focus on observing, discussing, and learning.

Each part of this system has been systematically studied, and participants will be exposed to novel data and new insights regarding sedimentary patterns and fundamental controls, including waves, tides, and geochemical and biological factors. Different Holocene environments that participants examine include:

- Shelf-margin barrier reef, the third longest in the Caribbean, and outboard drop-off and slope;
- Reef sand apron and back-reef shelf environments;
- Shelf-margin oolitic – skeletal shoal complex, shaped by tides;
- Grain-dominated platform interior, influenced by waves and tides;
- Progradational oolitic beach ridges;
- Tidal flat complex, including both a channeled belt and a progradational shoreline, with expansive hardgrounds; and
- Evaporative ponds.

Likewise, outstanding exposures of Pleistocene strata we will visit include:

- Shelf-margin reef and associated patch reef deposits; and
- Progradational, upward shoaling oolitic shoreline deposits.

In general, study of the Holocene offers several unique opportunities, including direct observation (and appreciation) of the scale of facies heterogeneity in plan view.



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Our observations will focus on:

- textures, grain types, organisms, sedimentary structures and early diagenetic alteration; and
- explicit and clear assessment of the influence of different variables (e.g., hydrodynamics, bathymetry, organisms) on these patterns. These will provide the basis for a deeper understanding of possible variability in reservoir analogs.

Itinerary (Subject to Change)

Day 0:

Arrive in Nassau

Day 1:

Transfer to Crooked Island, check in to Lodge, introductions, safety briefing

Classroom: Introduction to Bahamas and overview of CAP and the field trip

Field: Safety/swim check dive

Day 2:

Classroom: Modern carbonate sediment; carbonate diagenesis, seismic exercise

Field: "Restricted" islands, patch reefs

Goals/learning objectives:

- Introduction and hands-on review of Holocene biota, grains, and textures
- Geologic evolution of the Bahamas and seismic expression of carbonates
- Patch reef processes and dynamics

Day 3:

Field: Shoreface and foreshore, Pleistocene shoreface and reef outcrops

Goals/learning objectives:

- Observe present-day sediment distribution and dynamics across and along an extant carbonate shoreface and foreshore
- Examine the Holocene shoreface and stratigraphic succession
- Study a Pleistocene shoreface succession
- Discuss the nature, controls, and significance of early diagenesis (marine and meteoric)
- Examine a Pleistocene reef-oolitic succession in coastal outcrops; assess variability
- Characterize variability and sedimentology of carbonate shorefaces in the stratigraphic record and reservoir implications



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Day 4:

Field: Tidal systems: tidal flats, tidal inlets and delta

Goals/learning objectives:

- Observe tidal flat processes, environments, and sediments
- Study the vertical stratigraphic succession in core
- Characterize variability and sedimentology of tidal flats and deltas
- Evaluate sedimentology and processes in carbonate tidal deltas

Day 5:

Field: Platform interior, ooid sand shoal, red algal flat, lacustrine microbialites

Goals/learning objectives:

- Observe the sedimentology, stratigraphy, and geometry of oolitic tidal sand shoal system
- Characterize along-strike variability
- Understand the roles of waves, tides, and currents on platform sedimentary systems
- Provide perspectives on shoals throughout the Bahamas and in the geologic record
- Explore microbialites in an evaporative coastal lagoon

Day 6:

Field: Reef, backreef, and slope; karst in Pleistocene strata; Pleistocene reef outcrops (Bird Rock)

Goals/learning objectives:

- Observe the nature of shelf margin reefs and shelf systems
- Characterize their across- and along-strike variability
- Review the roles of waves and tides on reefs, reef sand aprons, and backreef shelves
- Summarize, review and provide perspectives on reefs and reef sand aprons globally
- Observe a platform-margin drop-off with syn-depositional fracturing; discuss slope and basal systems

Day 7:

Depart to Nassau and return home