Carbonate Environments and Sequences of Caicos Platform

Caicos, British West Indies to Miami Florida
July 20–26, 1989

Field Trip Guidebook T374

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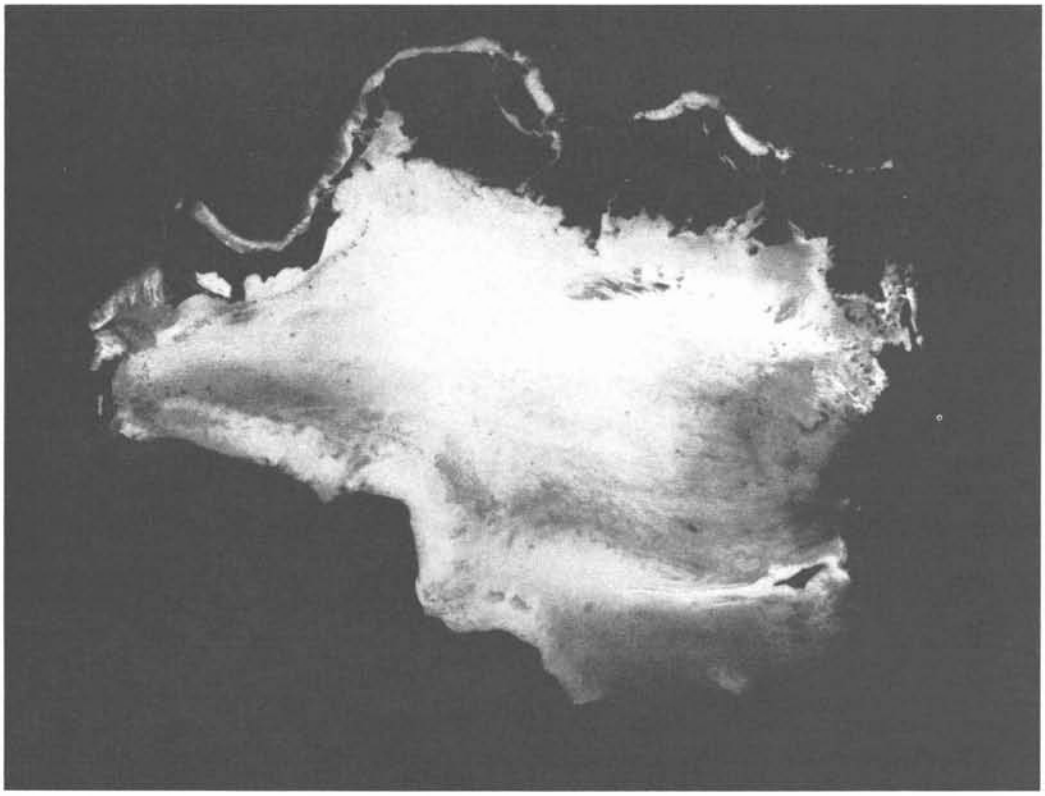

COVER Satellite image of Caicos Platform. Land areas are black. Deep off-platform areas are very dark. Very shallow and agitated bottoms are light. See Figure 25 for physiographic subdivisions and Figure 26 for distribution of sediment types (satellite image processing courtesy of UNOCAL).

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IGC FIELD TRIP T374:
CARBONATE ENVIRONMENTS AND SEQUENCES OF CAICOS PLATFORM,
with an Introductory Evaluation of South Florida

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INTRODUCTION

Goal of Field Excursion

The goal of this field excursion is to contrast the depositional environments and sedimentary facies of two carbonate platform settings: the south Florida carbonate peninsula and Caicos Platform. In doing this, we will not only contrast how physiographic setting and climate strongly influence shallow-marine carbonate sedimentation but, at the same time, present new alternative models of Bahamian sedimentation with direct application to the interpretation and prediction of comparable ancient carbonate facies and sequences.

In addition to containing a typical suite of Holocene sedimentary facies, Caicos Platform also exhibits superb outcropping Pleistocene marine and non-marine sequences, providing a rare opportunity to see how modern facies are preserved in three dimensions.

To allow comparison of major controls on shallow-marine carbonate sedimentation, this field excursion will begin by briefly examining Holocene sedimentary environments and facies forming in south Florida under the influence of a non-oceanic, low-relief, shelf setting and a rainy climate.

The remainder of the field trip will examine the complete spectrum of Holocene sedimentary environments and facies on Caicos Platform. Here, Holocene sedimentary facies occur across a shallow platform with steep margins adjacent to a deep oceanic environment and in a much more arid climate than observed in the northern Bahamas and southern Florida. Pleistocene sequences on Caicos platform illustrate not only how some of these facies and their diagnostic attributes are preserved but also help answer the broader question of Caicos Platform evolution during the Pleistocene.

Setting

This excursion visits two rather distinct geographic and climatic areas of the vast southern Florida platform and Bahamian archipelago (Fig. 1).

The south Florida carbonate shelf sits adjacent to the Straits of Florida, a relatively shallow intra-bank basin less than 700 meters in depth. The shelf extends as a relatively narrow belt from Miami southward to Key West and includes the broad, shallow mudbank areas of Florida Bay as well as the marginal reefal shelf.

Caicos Platform, part of the Turks and Caicos Islands, is situated approximately 800 km southeast of Miami in the southeastern chain of Bahamian platforms. It is located only 200 km north of Hispaniola and is completely surrounded by abyssal oceanic depths. The Turks and Caicos Islands are a British protectorate, politically independent from the Bahamas.

Tectonic Influence

The role of tectonics in south Florida and the Bahamas has long been controversial. Since Bullard *et al.* (1965) attempted to fit together North America and Africa using plate tectonic theory, the carbonate platforms of Florida and the Bahamas have been at the center of the controversy (Williams, 1985). Indeed, even the composition of the basement upon which these platforms developed and the control it had on the distribution of embayments and platforms remains unknown. According to Mullins and Lynts (1977), the northwestern Bahamian platforms are underlain by continental crust, and the origin of the deep Bahamian channels is related to Triassic rifting of North America. Others believe the basement is oceanic (Dietz and Holden, 1973) and the deep channels are the result of the Cretaceous disintegration of a megabank (Sheridan, *et al.*, 1981; Schlager and Ginsburg, 1981). Meyerhoff and Hatten (1974) and Uchupi *et al.* (1971) believe the northwestern Bahamas are underlain by continental crust, while the southern Bahamas are underlain by oceanic crust. The basement structure of Florida, however, is known to be continental (Barnett, 1975) suggesting that at least the northern Bahamian basement is also continental.

Caicos Platform lies to the north of an active tectonic margin (Fig. 1). The northern boundary of the Caribbean Plate runs along the northern coast of Hispaniola (Khudoley and Meyerhoff, 1971), 200 km to the south. A deep trough (Caicos Basin), extending westward from the Puerto Rico Trench, occurs 180 km south of the Caicos Platform. The Blake-Bahama

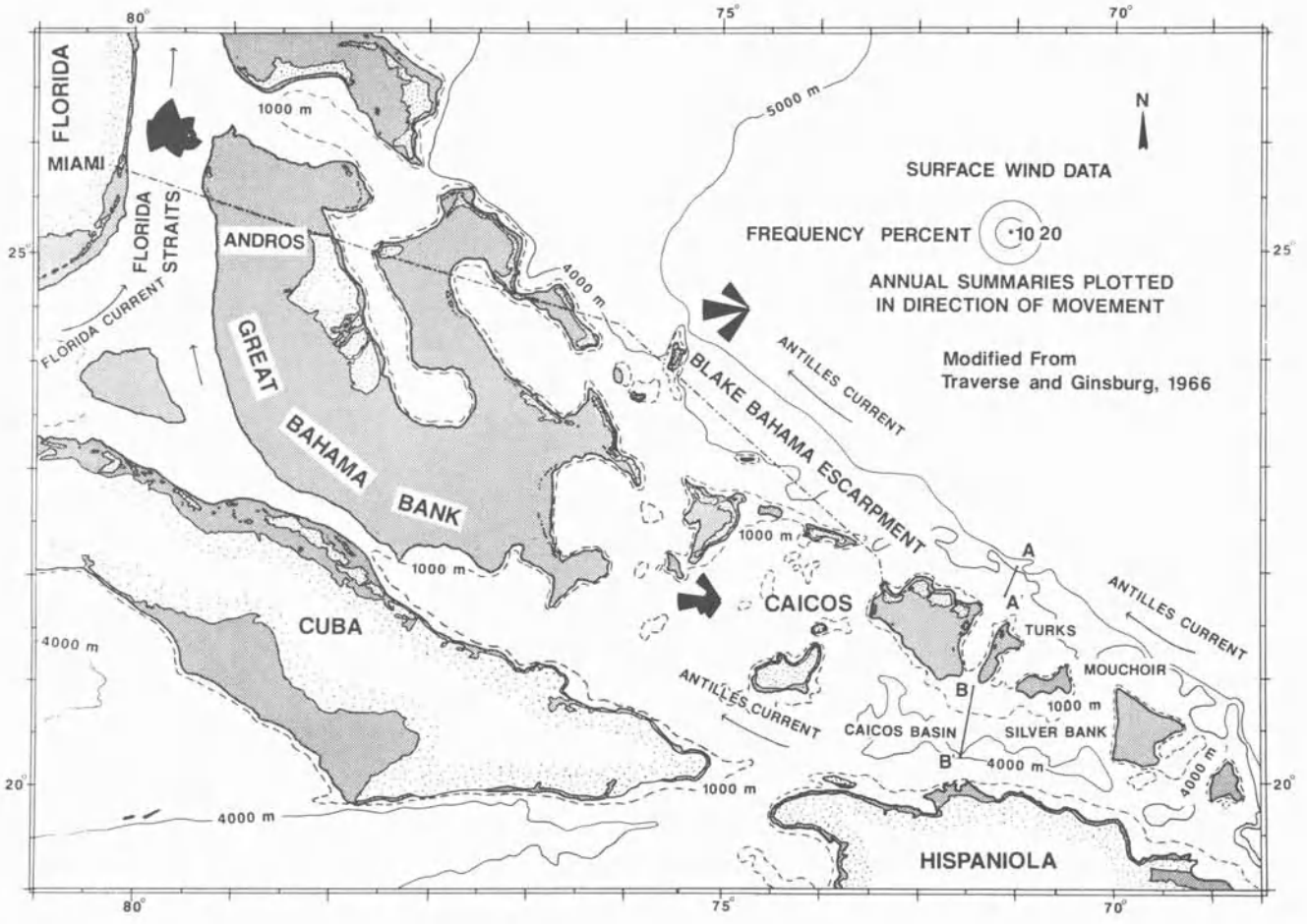

FIGURE 1 Map of south Florida and Bahamian platform chain showing land (stippled), platform areas less than 20 m in depth (shaded), the 1000, 4000 and 5000 m depth contours, surface winds, regional currents, commercial flight line from Miami to Providenciales (Dash-dot line) and location of multichannel seismic lines A-A' and B-B'.

Escarpment borders Caicos Platform to the north and is marked by a high-relief ridge (Fig. 2) that is thought to be a submerged Late Jurassic to Early Cretaceous reefal trend (Ball *et al.*, 1985). Caicos Platform is joined with Turks and Mouchoir Platform by a drowned platform of intermediate depth (marked by the 1,000 depth contour). Multichannel seismic lines extending southward from this intermediate depth platform reveal that the drowned platform (a) is increasingly tilted southward towards its margin and (b) has a faulted margin (Fig. 3).

Adjacent to the faulted margin is a tilted, fault-bounded, graben valley and a steeply dipping dropped platform block. These are interpreted as tensional features and are in contrast to the extensive compressional features also documented throughout the southeastern Bahamian region by Austin (1983). Significant southerly platform tilting has been reported from Silver Bank (Ball, personal communication). Williams (1985) proposed broad structural warping and possibly platform tilting as the cause for variable subsidence rates of individual Bahamian platforms. Whether compressional forces are presently affecting Caicos Platform and influencing its physiography is uncertain.

The southern margin of Caicos Platform possesses several concave reentrants suggestive of major erosional or slumping scars similar to those reported in Exuma Sound and Tongue of the Ocean (Schlager and Ginsburg, 1981).

Leeward Margin Growth and Platform Margin Evolution

In an effort to understand how carbonate platforms grow, expand and evolve, research during the past decade has gradually focused away from windward and towards leeward platform margins. Seismic analysis of the leeward margins of Little and Great Bahama Banks has shown that leeward margins are sites of lateral platform growth and accretion (Fig. 4, Hine and Neumann, 1977). Seismic lines across Great Bahama Bank, recently published by Eberli and Ginsburg (1987), dramatically demonstrate the prominent role that leeward margin processes play in the growth and evolution of detached carbonate platforms (Fig. 5). These lines show that the vast Great Bahama Bank is composed of at least three narrow, north-south trending banks separated by interplatform seaways

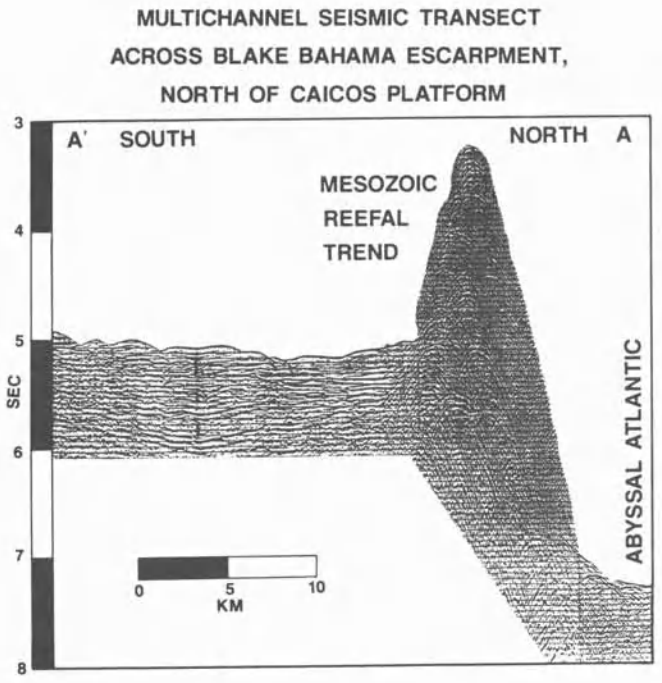

FIGURE 2 Multichannel seismic transect A-A' across Blake Bahama Escarpment to the north of Caicos Platform. See Figure 1 for location.

comparable in depth to the present Tongue of the Ocean and Exuma Sound (1000-2000 m). These small banks have coalesced into the present expansive Great Bahama Bank by lateral accretion sufficient to completely infill former seaways.

Prior to this recognition, several studies had documented the character and evolution of leeward margins during the Holocene transgression. Palmer (1979), working on eastern Great Bahama Bank, and Wilber (1981), studying Little Bahama Bank, both recognized a vertical change on the leeward margin from reefal buildups to skeletal/nonskeletal packstones and wackestones. They found that this change occurred as rising sealevel flooded the adjacent platform and hydrodynamic processes transferred large volumes of platform sediment to and across the leeward margins.

Leeward margin sedimentation and evolution on the western margin of Caicos Platform are evaluated toward the end of this field excursion.

Environmental Gradients

Much of this excursion is focused on an evaluation of those environmental parameters which most strongly influence the occurrence, distribution and attributes of Holocene and Pleistocene carbonate sediments in the Bahamian archipelago. Understanding these controls is essential to formulating actualistic models that can be used to guide the study of ancient carbonate sequences

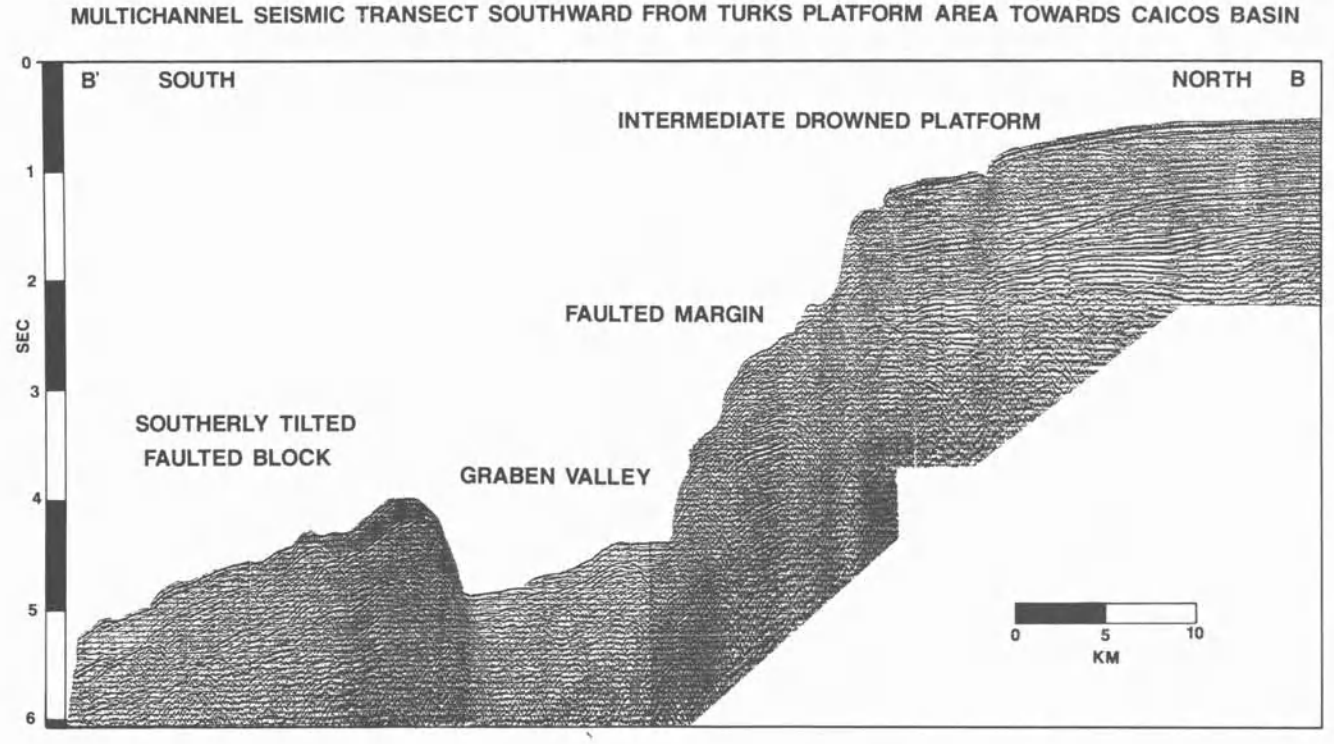

FIGURE 3 Multichannel seismic transect B-B' located southward from the Turks Platform area towards Caicos Basin. See Figure 1 for location.