INTRODUCTION

OBJECTIVES

Leg 11 of the Deep Sea Drilling Project began in Miami, Florida on April 8, 1970 and ended in Hoboken, New Jersey on June 1, 1970. During this eight-week cruise 11 sites were drilled in the western North Atlantic (Figure 1) in an attempt to achieve the broad scientific goals of the project and to pursue the more specific objectives outlined below:

1) to recover the oldest in-place material from the top of the ocean crust as near the continental margin as possible in an attempt to date the age of the western Atlantic and from this data infer the age of the breakup of North America and Africa; 2) to determine the paleo-environment of the developing Atlantic; 3) to sample and date the prominent seismic reflection horizons that lie below much of the western Atlantic; 4) to determine the composition and origin of the massive accumulation of sediment that forms the Blake-Bahama Outer Ridge system and the continental rise off North America; and 5) to gain more knowledge about the structure and history of the Bahamian carbonate province.

The operational statistics of Leg 11 are given in Table 1.

According to modern concepts of sea-floor evolution, the Atlantic ocean basins are growing laterally from a median line, the rift valley at the crest of the mid-Atlantic Ridge. Thus the oldest part of the Atlantic should be found at the edges of the basins, that is near the continental margins. Unfortunately, sediment thicknesses are usually greatest here and in order to obtain old sediment with the present techniques of deep sea drilling, it is necessary to find areas where the sediment cover is anomalously thin. Seismic reflection records have revealed less than 500 meters of semiconsolidated material lying on what is probably the primordial ocean crust northeast of the Bahamas (Ewing *et al.,* 1966; Windisch *et al.,* 1968), and here deep drilling on Leg 1 recovered late Jurassic sediment from a subbottom depth of less than 300 meters. Due to drilling difficulties in hard chert layers, attempts at deeper penetration had to be abandoned on Leg 1. Chert bits similar to those used successfully in the oil fields had become available to the project for Leg 11, so a second effort to drill and sample the entire sedimentary section in the Cat Gap area was given priority in the planning of this leg.

Seismic investigations across the Blake-Bahama Outer Ridge reveal a massive pile of relatively homogeneous seismically transparent sediment lying on a flat reflecting horizon—Horizon A—of middle Eocene to late Cretaceous age, (Ewing and Ewing, 1964; Ewing *et al.*, 1966; Saito *et al.,* 1966). Several theories have been postulated for the formation of this ridge. Although a model based on gravity tectonics has been suggested (Andrews, 1967), most marine geologists agree that bottom water circulation has played a role in its development (Heezen and Hollister, 1964; Heezen *et al.,* 1966; Markl *et al.,* 1970). Nevertheless, uncertainty exists concerning the source of sediments and the competency of bottom water in carrying such vast amounts of sediment. Four sites were drilled on the Blake-Bahama Outer Ridge system in order to determine the composition, stratigraphy, provenance and rate of accumulation of the material that make up this distinctive sedimentary feature.

The continental rise off the eastern United States is one of the largest accumulations of deep sea sediment on the surface of the earth, and its composition beneath the upper twenty meters normally accessible to piston coring techniques has, until the Deep Sea Drilling Project, remained unknown. Numerous attempts have been made using seismic reflection and refraction data to infer its composition and origin. Three different modes of continental rise formation have been proposed during the last two decades. Seismic refraction data taken during the 1950's first revealed the rise to be a thick geosynclinal wedge presumably composed of sedimentary material. Geophysicists have suggested that it is a huge trough filled with turbidity-current-transported coarse terrigenous debris (Drake *et al.*, 1959; Dietz, 1963 and 1964). Some workers compared these deposits to those found in large alluvial fans. Later work with seismic reflection techniques has suggested to some that the rise results from massive gravity sliding or slumping of detrital sediment (Callard, 1966; Emery *et al.*, 1970) initially deposited on the continental slope. Some marine geologists have argued that the entire continental rise off North America owes its shape *not* to the effects of downhill-flowing turbidity currents, slumps or slides, but to the contour-following transport by deep thermohaline circulation of fine-grained sediment (Heezen *et al.,* 1966). The latter view contends that fine-grained sediment periodically transported through submarine canyons in turbulent suspension by turbidity-current action will be incorporated into the steady bottom currents and transported down-current, not downslope, in a direction approximately 90° from the axis of the canyons. Thus, most of the fine sediment found on the continental rise would have a source further up-current as well as upslope. Three holes were drilled on the

Figure 1. *Physiographic diagram of a portion of the western North Atlantic (Heezen and Hays, 1968) with locations of Leg 11 drilling sites.*

TABLE 1
Drilling Statistics for Leg 11

Hole	Latitude N	Longitude W	Date	Water Depth meters	Water Depth feet	Penetration meters	Penetration feet	Number of Cores	Amount meters	Cored feet	Amount meters	Recovered feet
98	25°22.95′	77°18.68′	April 10, 11	2769	9086	357	1171	15	122.0	400	79.50	260
99	23°41.14′	73°50.99′	April 14	4914	16,123	84	276	0	0.0	0	0.00	0
99A	23°41.14′	73°50.99′	April 15-18	4914	16,123	248	814	14	96.0	315	29.25	96
100	24°41.28′	73°47.95′	April 20-23	5325	17,471	331	1086	13	93.0	305	29.50	96
101	25°11.93′	74°26.31′	April 25	4868	15,972	76	249	2	18.0	59	15.80	50
101A	25°11.93′	74°26.31′	April 26-28	4868	15,972	691	2267	10	89.0	292	23.20	76
102	30°43.93′	74°27.14′	May 1-4	3426	11,241	661	2169	19	268.0	879	99.10	325
103	30°27.08′	74°34.99′	May 5-6	3964	13,006	449	1473	7	62.0	203	36.94	121
104	30°49.65′	74°19.64′	May 7-9	3811	12,504	617	2024	10	83.0	272	56.10	184
105	34°53.72′	69°10.40′	May 13-19	5251	17,229	633	2077	43	341.0	1119	196.60	645
106	36°26.01′	69°27.69′	May 20-21	4500	14,764	349	1145	6	48.0	157	21.50	70
106A	36°26.01′	69°27.69′	May 22	4500	14.764	361	1184	0	0.0	0	0.00	0
106B	36°25.28′	69°25.81′	May 23-26	4504	14,778	1015	3330	8	55.5	188	38.60	126
107	38°39.59′	72°28.52′	May 28	2571	7199	78	218	2	12.0	34	1.50	4
108	38°48.27′	72°39.21′	May 29-30	1845	5170	209	585	4	36.0	101	7.20	20
						6159	20,301	150	1324	4343	635	2083

continental rise and one on the continental slope to provide tests of these hypotheses.

The sites in all three of these areas–Cat Gap, Blake-Bahama Outer Ridge and Continental Rise–presented good opportunities to sample and date major seismic reflectors and to determine the lithologic changes responsible for this reflectivity.

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EXPLANATORY NOTES

Responsibilities of Authorship

In Part I, Shipboard Site Reports, the responsibility of authorship was shared by the entire shipboard scientific party, the authors are listed (with the exception of the co-chief scientists) in alphabetical order for each site. Responsibilities were distributed as follows: Background, Objectives, Operations and Conclusions–C. D. Hollister and J. I. Ewing; Lithology–J. C. Hathaway, Y. Lancelot and F. J. Paulus; Biostratigraphy–D. Habib, H. P. Luterbacher, C. W. Poag and J. A. Wilcoxon; Physical Properties–F. J. Paulus.

Individual contributions by certain members of the shipboard party appear in Parts II, III and IV.

Shipboard and Shore Laboratory Scientific Procedures

The shipboard scientific procedures are the same as those described fully in Appendix II of Volume II and

Appendix II of Volume VI of the *Initial Reports of the Deep Sea Drilling Project.*

Methods used in the shore laboratory studies are, in most cases, given here or referenced in the relevant chapters. Methods used in the Deep Sea Drilling Project shore laboratories for grain-size, carbon carbonate and X-ray diffraction determinations are given in Appendix III of Volume IV, *Initial Reports of the Deep Sea Drilling Project*.

Data Presentation

In each Site Report, except for Site 108 (Chapter 9), the illustrations appear in the same sequential order, as follows: location of the site and seismic profiling tracks (Figure 1); seismic profiler records and interpretation (Figure 2); site stratigraphic summary chart (Figure 3); coring summary table (Figure 4); smear-slide graphic summary (Figure 5)[1]. Additional figures numbered from 6 onward, when present, refer to illustrations of particular aspects of each site. The detailed core graphic representations together with lithological descriptions, summarized paleontological data, and physical properties plots appear after the text of each Site Report. Some core sections of particular interest are displayed separately on a larger scale for more detailed illustration. Core photographs are given at the end of each chapter. (See Figure 2 for lithologic symbols and abbreviations used in the core logs.)

Sediment Classification

In this volume the following simplified sediment classification has been adopted:

Carbonate sediments:

Ooze (with indication of the main component such as nannoplankton or foraminifera) refers to a non-indurated calcareous sediment.

Chalk (with the same indication as above) refers to an indurated calcareous sediment in which calcite recrystallization is of only minor importance.

Limestone refers to a well-indurated calcareous sediment which shows a high degree of calcite recrystallization.

Whenever substantial amounts of clay minerals are present the adjective "clayey" has been added to the above terms.

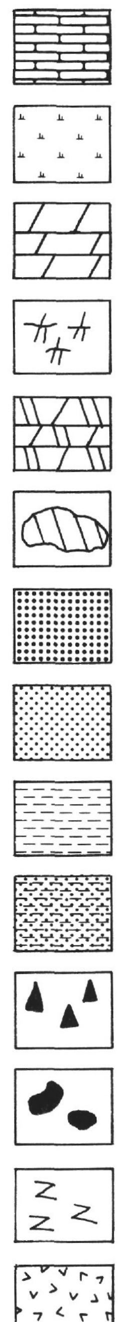
Other sediments:

Hemipelagic mud refers to a sediment in which both terrigenous detrital elements (clay and silt-sized) and biogenic elements are abundant.

Other terms, such as, sand, silt, clay, zeolitic clay, claystone, etc., are used in the standard sense.

[1]The smear-slide graphic summaries, identified as Figure 5 in Chapters 1 through 7, are presented as foldouts at back of volume.

Following are the basic lithologic symbols appearing in all stratigraphic columns except those which are otherwise individually keyed. In cases where there are admixtures of the basic components, the appropriate symbols have been combined and where special symbols have been used, the lithotype is described in the adjacent column.



SYMBOL	LITHOTYPE REPRESENTED
	Limestone or Nannoplankton Chalk
	Nannoplankton or Foram-Nannoplankton Ooze or Calcareous Component
	Dolomitic Limestone
	Dolomite
	Ankerite
	Siderite
	Sand
	Silt
	Clay
	Hemipelagic - Silty Clay or Mud
	Chert
	Pyrite
	Zeolites
	Basalt

Certain key samples are noted in the "Sample Interval" column appearing in the visual core descriptions. These are coded as follows:

AP	– Ammonite Aptychi	PA	– Palynomorphs
C	– Crinoids	PF	– Planktonic Foraminifera
CN	– Calcareous Nannoplankton	SS	– Smear Slide
D	– Dinoflagellates	TIN	– Tintinnids
F	– Foraminifera	TS	– Thin Section
O	– Ostracods	WR	– Washed Residues