OCEAN DRILLING PROGRAM

LEG 101 PRELIMINARY REPORT

BAHAMAS

James A. Austin, Jr.
Co-Chief Scientist, Leg 101
Institute for Geophysics
University of Texas, Austin
4920 North IH 35
Austin, TX 78751

Wolfgang Schlager
Co-Chief Scientist, Leg 101
Rosenstiel School of Marine
and Atmospheric Sciences
4600 Rickenbacker Causeway
Miami, FL 33139

Amanda A. Palmer
Staff Science Representative, Leg 101
Ocean Drilling Program
Texas A & M University
College Station, TX 77843-3469

Philip D. Rabinowitz
Director
ODP/TAMU

Robert B. Kidd
Manager, Science Operations
ODP/TAMU

Louis E. Garrison
Deputy Director
ODP/TAMU

15 April 1985

Preliminary Report No. 1

First Printing 1985

Distribution

Copies of this publication may be obtained from the Director, Ocean Drilling Program, Texas A & M University, College Station, Texas 77843-3469. In some cases, orders for copies may require a payment for postage and handling.

DISCLAIMER

This publication was prepared by the Ocean Drilling Program, Texas A & M University, as an account of work performed under the international Ocean Drilling Program which is managed by Joint Oceanographic Institutions, Inc., under contract with the National Science Foundation. Funding for the program is provided by the following agencies:

Department of Energy, Mines and Resources (Canada)

Deutsche Forschungsgemeinschaft (Federal Republic of Germany)

Institut Francais de Recherche et d'Exploitation de la MER (France)

Ocean Research Institute of the University of Tokyo (Japan)
(as of October, 1985)

National Science Foundation (United States)

Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation, the participating agencies, Joint Oceanographic Institutions, Inc., Texas A & M University, or Texas A & M Research Foundation.

SUMMARY OF SCIENTIFIC RESULTS

SUMMARY OF OCEAN DRILLING PROGRAM LEG 101

The scientific party aboard JOIDES RESOLUTION for Leg 101 of the Ocean Drilling Program consisted of:

James A. Austin, Jr. (University of Texas Institute for Geophysics, Austin, Texas) Co-Chief Scientist

Wolfgang Schlager (Rosenstiel School of Marine and Atmospheric Sciences, Miami, Florida) Co-Chief Scientist

Paul Comet (The University, Newcastle-Upon-Tyne, Newcastle, England)

Andre Droxler (Rosenstiel School of Marine and Atmospheric Sciences, Miami, Florida)

Gregor Eberli (Geologisches Institute, ETH-Zentrum, Zurich, Switzerland)

Eric Fourcade (Universite Pierre et Marie Curie, Paris, France)

Raymond Freeman-Lynde (University of Georgia, Athens, Georgia)

Craig Fulthorpe (Northwestern University, Evanston, Illinois)

Gill Harwood (The University, Newcastle-Upon-Tyne, Newcastle, England)

Gerhard Kuhn (Geologisches Institute, Gottingen F.R.G.)

Dawn Lavoie (NORDA, Seafloor Sciences Division, NSTL, Mississippi)

R. Mark Leckie (Woods Hole Oceanographic Institution, Woods Hole, Massachusetts)

Allan Melillo (Rutgers University, New Brunswick, New Jersey)

Arthur Moore (Marathon Oil Company, Littleton, Colorado)

Henry Mullins (Syracuse Unversity, Syracuse, New York)

Amanda Palmer (Ocean Drilling Program, Texas A&M University, College Station, Texas)

Christian Ravenne (Institute Francias du Petrole, Paris, France)

William Sager (Texas A&M University, College Station, Texas)

Peter Swart (Fisher Island Station, University of Miami, Miami, Florida)

Joost Verbeek (Geological Survey of the Netherlands, Haarlem, Netherlands)

David Watkins (University of Nebraska, Lincoln, Nebraska)

Colin Williams (Lamont-Doherty Geological Observatory, Palisades, New York)

INTRODUCTION

The scientific objectives of drilling in the Bahamas were to understand the evolution of the modern configuration of shallow-water carbonate banks and intervening deep-water troughs, and to study the growth patterns of carbonate slopes and their response to sea-level fluctuations. The formulation of these objectives was based both on previous sedimentological investigations, reinterpretations of recently released data on industry boreholes in the Bahamas, and regional and site-specific seismic surveys (Figure 1, 2). Results and interpretations of drilling results are presented separately here for the deep (megabank) and shallow (platform flanks) objectives.

DEEP OBJECTIVES: "MEGABANK" VS. "GRABEN" HYPOTHESES

Background and Objectives

Leg 101 was designed in part to test two fundamentally different hypotheses for the long-term crustal evolution of the Bahamas. The "megabank" hypothesis holds that the modern archipelago is underlain by a drowned shallow-water platform, while the "graben" hypothesis suggests instead that the present topographic configuration is a faithful reflection of underlying horsts and grabens related to Mesozoic rifting of North America and Africa. On regional multichannel seismic reflection profiles, the inferred top of the "megabank" is marked by a high-amplitude reflection with a pronounced compressional wave velocity increase to more than 4 km/sec (Figure 3). During Leg 101, six sites were drilled in an attempt to sample this horizon: 626, 627, 632, 634, 635, and 636 (Figures 2 and 4).

Main Observations

"Megabank" vs. "Graben" Hypotheses

The origin of Bahamian banks and basins has been and still is the subject of intensive debate because the pattern is unusual for passive ocean margins. For the last decade, the discussion has been governed by two fundamentally different concepts: The graben hypothesis calls for strong fault control of the bank-and-basin pattern. It assumes that the present deep-water basins originated as grabens in the rift stage of the Atlantic and have remained topographic lows ever since (Mullins and Lynts, 1977). The megabank hypothesis (Sheridan et al., 1981) assumes that rift structures and other inherited tectonic features were soon smothered by sediments during the spreading phase of the Atlantic ocean and that for most of the Jurassic and the early Cretaceous, Florida, the northwestern Bahamas and northern Cuba formed a single, flat-topped carbonate platform. In the Cretaceous, this platform (the "megabank") gave way to the present array of banks and basins.

The debate continues in the wake of drilling. Most of the scientific party feel that Leg 101 and the preceding seismic site surveys have greatly strengthened the megabank hypothesis. However, at least one member (Mullins) considers the evidence inconclusive, mainly because in the Straits of Florida and Northeast Providence Channel we failed to reach the relevant seismic horizon. Mullins prefers to emphasize that early Cretaceous sediments were recovered on DSDP Leg 77, in dredge hauls from Samana (Schlager et al., 1984), and also on this leg from Site 635. On the basis of this evidence, he suggests that multiple bathyal embayments were already established at that time.

Leg 101 recovered shallow-water carbonates and evaporites of the megabank under the southern Blake Plateau. In the Straits of Florida, the carbonate platform was not reached but a close stratigraphic tie was established with an exploration well on Great Bahama Bank, 60 km to the northeast. The continuity of seismic records in the region between Site 626 and the Great-Isaac I well strongly suggests that the entire Straits of Florida is underlain by a continuous carbonate platform. The two holes indicate, furthermore, that the margin of Great Bahama Bank has not remained stationary since the mid-Cretaceous, but rather has alternately retreated and prograded tens of kilometers during the past 100 Ma. Blake Plateau and Little Bahama Bank display a similar rhythm of mid-Cretaceous drowning and retreat followed by Late Tertiary expansion of the platforms (Fig. 6).

The evidence for wide horizontal migration of the platform margins and for shallow water carbonates underneath at least some Bahamian basins is not easily reconciled with the graben hypothesis of the Bahamian troughs (Sheridan, et al., 1981).

The mid-Cretaceous disintegration of the megabank does not seem to be related to local tectonic deformation but rather to a crisis in the depositional system. The drowning of the Bahama platform is part of a world-wide extinction of carbonate platforms that coincides with a tendency towards oxygen deficiency in the world ocean (Schlager, 1981). Exploring possible links between anoxia and platform drowning remains one of the most challenging tasks for the shipboard party.

Although most of the scientific party feel that while drilling tipped the balance in favor of the megabank hypothesis, it also calls for some modifications of that concept. The stratigraphy of the Leg 101 sites, along with recent dredging results, indicate that mid-Cretaceous platform drowning was not synchronous throughout the archipelago and that it predates the mid-Cenomanian sea level cycle of Vail and others (1977). Drowning seems to have progressed in steps from the southeastern perimeter of the megabank to the center. The oldest known deepwater sediments at the southeastern tip of Great Bahama Bank (Samana) are Neocomian in age (Schlager et al., 1984); at Site 635, 350 km farther northwest, they are Albian; at Site 627 and in the Great-Isaac 1 well, in the center of the archipelago, they are Cenomanian in age.

Hydrocarbon Shows

Hydrocarbon shows were encountered at several sites and led to abandonment of two holes. Oil stains and wet gas were found in Cretaceous dolomites on southern Blake Plateau, and tar impregnations appeared in Miocene chalks in the Straits of

Florida and in turbidites in Exuma Sound. All these shows interpreted to be migrated hydrocarbons derived from deeper parts of the section. In accordance with ODP practice, these holes were plugged with cement.

Downhole Measurements

Continuous coring of ODP holes is complemented by wireline logging with a suite of high-technology tools. At Site 634, a Gamma Ray Spectroscopy Tool (GST) successfully measured the elemental concentrations of Fe, Ca, Si, S, Cl, H, C, and O, identifying basic lithology and porosity.

RESULTS FROM EACH SITE

Straits of Florida

Site 626

The first site of Leg 101 was also the most technically difficult: sampling an inferred platform top at approximately 1200 m subbottom beneath the axis of the modern Gulf Stream. Hole 626A consists of two cores which represent a failed attempt to spud into a hardground. Hole 626B retrieved five cores while washing to a depth of 185.5 m BSF. Hole 626C recovered the upper part of the section wih HPC/XCB coring. Hole 626D was a rotary attempt to reach the target reflector which was abandoned because of unstable hole conditions at a depth of 447 m subbottom.

Although the deep target was not reached, Site 626 produced important initial results:

1. Winnowed, unconsolidated sands throughout the section suggest that the Gulf Stream has been a pervasive erosional and depositional agent since at least the late Oligocene. The presence of these sands created the difficult drilling conditions at this location.

2. Middle Miocene debris flows/turbidites are coeval with similar deposits in the Blake-Bahama Basin (DSDP Sites 391 and 534) and may have a common cause.

3. Correlation of the late Paleogene-Neogene stratigraphy between Site 626 and the Great Isaac-1 exploratory well on Great Bahama Bank 60 km to the northeast (Figure 1) suggests substantial northwestward progradation of the bank since the late Miocene. Prior to that time, deep-water facies in the two wells are similar and time-lines are nearly horizontal, findings at variance with the "graben" hypothesis in this part of the Bahamas.

Northern Slope, Little Bahama Bank

Site 627

Two holes were drilled at this site, Hole 627A which was abandoned after failing to recover the mudline, and Hole 627B, which succeeded in sampling the top of a buried shallow-water carbonate platform, a sequence of intercalated dolomitized limestones and gypsum from 468-536 m subbottom. Comparison of the depth of occurrence of these rocks with the geophysical data supported the pre-drilling correlation of platform rocks with compressional wave velocities in excess of 4 km/sec, indirect support for the "megabank" hypothesis in the northern Straits of Florida/southern Blake Plateau.

In addition to calibrating the depth of the transition to shallow-water material, Site 627 also illustrated the successive transformation of the platform, first into a mixed carbonate-terrigenous shelf during the Cenomanian, then a marginal oceanic plateau characterized by frequent hiatuses (perhaps the result of intermittent Gulf Stream/Antilles Current flow through this region) between the Campanian and Oligocene, and finally the turbidite apron of a prograding Little Bahama Bank.

Abandonment of Site 627 was forced by the presence of hydrocarbon gas and oil shows in the shallow-water platform carbonates and evaporites.

Basin Floor, Exuma Sound

Site 632

Site 632 was an unsuccessful deep-penetration attempt to an inferred platform top-velocity discontinuity at 1300 m subbottom in order to compare and contrast the Exuma Sound section with the stratigraphic development of the Straits of Florida. Two holes were drilled at this site, a HPC/XCB hole (632A) to recover the upper section (0.0-141.0 m BSF), and a rotary hole (632B) to recover the lower section (120.7-283.3 m BSF).

Even though the target horizon was not reached, this site served successfully as the basinward end of the Exuma Sound slope transect described below.

Eastern Flank, Northeast Providence Channel

Site 634

Site 634 was effectively a reoccupation of DSDP Site 98. Its goal was to sample to an estimated depth of 800 m subbottom the same velocity discontinuity inferred to be a platform top left unsampled at Site 632. Once again, poor hole conditions forced premature abandonment at 480 m subbottom in bioclastic turbidites and debris flows of early Campanian age. Fortunately, Compensated Neutron and Gamma Spectroscopy logs run in the drill string provided detailed information on both porosities and lithologies poorly recovered by drilling. The available data did allow recalibration of two regionally correlated acoustic horizons at the site, both of which were older than previously assumed.

Western Flank, Northeast Providence Channel

Site 635

Site 635 was located approximately two nautical miles northwest of Site 634, on the facing flank of the canyon system. Hole 635A consists of three cores representing a failed spud-in attempt. Hole 535B retrieved fourteen rotary cores before a stuck core barrel forced abandonment of the hole.

The target again was the presumed platform top left unsampled at 634. The seismically estimated depth to that horizon at this location was only 200 m, but unconsolidated sand (probably recent canyon-fill) forced abandonment at only 118 m subbottom. Recovery of slightly argillaceous limestones of early late Albian-earliest Cenomanian age from 61-118 m subbottom, when compared with the latest Albian-earliest Cenomanian marls immediately overlying the platform at Site 627, strongly suggests that drowning of any inferred "megabank" has been diachronous. This conclusion is strengthened by the fact that the Site 627 marls are clearly neritic, while the older Site 635 fauna have bathyal affinities. Differential subsidence, perhaps along faults, might explain this diachroneity, and also account for the more than two km difference in elevation between the sampled platform top at Site 627 and the inferred top beneath Northeast Providence Channel.

Of particular interest are dark-colored, laminated zones within these limestones which are characterized by high total organic carbon content, occasionally in excess of 6%. These zones are coeval with some of the "black" shales of the western North Atlantic, and provide additional evidence for oxygen deficiency in the world's oceans during the Cretaceous.

Canyon Axis, Northeast Providence Channel

Site 636

Site 636 was a final attempt at the end of Leg 101 to sample the inferred platform top in this part of the Bahamas. The target horizon was at approximately 100 m subbottom in this location, but penetration to only 21 m subbottom could be achieved in the time remaining. Fragments of platform carbonate material were recovered from a presumed Neogene debris flow in the unconsolidated canyon-fill.

SHALLOW OBJECTIVES: CARBONATE SLOPE TRANSECTS

Background and Objectives

Previous investigations of Bahamian slopes based upon seismic results, dredging, and piston coring have suggested that they steepen with time and height, are characterized by facies belts which generally parallel bathymetric contours, and respond very differently from their silicilastic counterparts to relative changes in eustatic sea-level. Leg 101 addressed the three-dimensional development of these slopes with two transects, the first north of Little Bahama Bank and the second in the southeastern part of Exuma Sound (Figure 2).

Main Observations

Platform Flanks: Facies Patterns and Response to Sea Level Fluctuations

Platform flanks were studied in two 3-hole transects using the Hydraulic Piston Corer. The response of platform flanks to sea level fluctuations has recently become the focus of a lively discussion (Thiede, 1981; Mullins, 1983; Shanmugam and Moiola, 1983) and was one of the principal objectives of Leg 101. Vail and others (1977), in their pioneering contribution on seismic stratigraphy and sea level history, assume that during a sea level cycle sediment is fractionated between shelf and basin in but one way: during high-stands of sea level most sediment is trapped on the inner shelf, and during low stands when rivers carry their load right to the shelf edge, most material escapes to the deep sea. Results of Leg 101, along with increased data on the late Pleistocene, indicate that carbonate platforms do not fit this trend.

Preliminary comparisons of stratigraphy on the Bahama banks and in the basins strongly suggest that periods of low sea level and bank exposure 3 Ma and 5-6 Ma ago correspond to intervals of slow deposition and scarcity of turbidites in the basins. When sea level was high and the banks were flooded, sedimentation rates in the basins increased dramatically. This observation supports the concept of "high-stand shedding" of platforms as opposed to the generally accepted phenomenon of "low-stand shedding" of terrigenous continental margins.

The fine sediment exported by the platforms consists largely of aragonite, a form of calcium carbonate that is metastable in most burial environments and is rarely found in pre-Quaternary pelagic sediments. On the flanks of the platforms, bank-derived aragonite mixes with the remains of calcitic plankton. Bahama drilling provided the first glimpse of the burial history of this peculiar type of carbonate ooze. The first-order trend shows downhole decrease of aragonite and replacement by calcite cement. Whereas calcite cementation is more rapid than in pelagic carbonate ooze, aragonite dissolution was found to be unexpectedly slow, and 7 Ma-old limestones were found to contain 15-20% aragonite. Superimposed on this first-order trend are cyclic variations in aragonite content. In the Quaternary, these have been shown to reflect climatic cycles. Further study of the Leg 101 cores is expected to reveal the Neogene climatic history of the platforms.

RESULTS FROM EACH SITE

Overview: Little Bahama Bank

The northern slope of Little Bahama Bank (LBB) was chosen for study as a good example of a relatively gentle (2-3 degrees) "accretionary" slope of modest height (800-900 m), one characterized by slumps, gravity flows and turbidites prograding seaward with time. Three sites sampled this slope with the Hydraulic Piston Corer/Extended Core Barrel: 627, 628 and 630 (Figure 2, 5).

Little Bahama Bank, Basinward Site

Site 627

In addition to being the only Leg 101 site which successfully sampled a shallow-water platform, Site 627 acted as the basinward end of the LBB slope transect. The sampled section clearly chronicles the transition from a Campanian oceanic plateau with minimal off-bank input to a middle Miocene and younger turbidite apron characterized by periplatform ooze with frequent turbidites, debris flows, and slumps. These facies are interpreted as marking the steady northward advance of LBB, complicated by numerous hiatuses which suggest the pervasive, if episodic, influence of Gulf Stream/Antilles Current.

Little Bahama Bank, Mid-Slope Site

Site 628

Site 628, located approximately at the modern toe-of-slope of LBB, was expected to show evidence for bank progradation earlier than at Site 627. As expected, the sampled sediments suggest a transition from a marginal plateau experiencing only pelagic deposition to a slope-base environment receiving frequent turbidites in late Oligocene time. The upper Oligocene section at this location is at least 75 m thick, indicating accumulation rates as high as 27 m/my.

Seismic evidence for downslope movement along imbricate thrust planes and bedding-plane shears complicates the stratigraphic correlation of Sites 628 and 627, suggesting that such processes may be important on gentle carbonate slopes where accumulation rates are large.

Little Bahama Bank, Landward Site

Site 630

Site 630 was located on an interfluve within the upper, gullied part of the LBB slope. Previous investigations had suggested that coarse, off-bank detritus should be confined to these gullies on its way basinward, leaving the interfluves with a reasonably undisturbed pelagic record very sensitive to sea-level fluctuations. The results support this contention, at least for the last 6 my. Since the late Miocene, 124 m of periplatform ooze containing abundant bank-derived aragonite (but hardly any turbidites) have been deposited, yielding a depositional rate of 28 m/my or higher. Deeper in the section, turbidites abruptly increase in frequency, suggesting seaward progradation of the gullied slope over the turbidite apron.

Hole 630A recovered twenty-six HPC/XCB cores to a total penetration of 250.3 m BSF. Hole 630B duplicated the HPC section (0.0-80.4 m BSF), and allowed physical properties whole round core sampling for consolidation triaxial testing. A third hole, 630C consists of a single mudline core for high-resolution interstitial water sampling.

At all three of the LBB sites, cementation within the Tertiary and younger section was minor and decreased downward. This may reflect low input of organic matter, thereby allowing complete aerobic destruction of any organic material prior to burial on this slope.

Overview: Exuma Sound

The southwestern margin of Exuma Sound (ES) was chosen as the second slope transect of Leg 101 in order to compare and contrast a gentle "accretionary" slope with a steeper (10-12 degrees), higher (1600 m) slope where sedimentation rates were expected to be much lower and bypassing of bank derived sediments much more pronounced. Exuma Sound also provided an opportunity to compare an open-ocean slope (LBB) with a completely sheltered one, particularly in terms of their resonse to fluctuating sea levels. Three sites were located and drilled on this slope, again with the Hydraulic Piston Corer/Extended Core Barrel: 632, 633 and 631 (Figure 2, 5).

Exuma Sound, Basinward Site

Site 632

Site 632 was the basinward end of this transect. Approximately 283 m of upper Miocene and younger periplatform ooze, chalk, and limestone with intercalated turbidites were sampled. Shallow subsurface diagenesis at this location was rapid, leading to extensive lithification. Bank-derived aragonite was also present throughout the sampled section. Rates of sedimentation were very high, up to 120 m/my in the late Miocene-early Pliocene.

Fluctuations in depositional rates at this site appeared to covary with lithology, with turbidite-rich sequences deposited more rapidly than those composed primarily of periplatform material. A preliminary correlation with global sea level based on oxygen isotopes and other evidence on the adjacent bank suggests that these turbidite maxima correspond with sea-level highstands, supporting the contention that carbonate environments are 180 degrees out-of-phase with their siliciclastic counterparts in their response to such fluctuations.

The presence of marginally mature bitumen in the pore spaces of upper Miocene periplatform grainstone turbidites recovered near the base of the hole forced its early abandonment.

Exuma Sound, Mid-Slope Site

Site 633

Located just a few km basinward of the toe-of-slope, Site 633 sampled 227 m of upper Miocene (?) and younger sediments. This section is composed of three distinctly different lithologic untis. The basal sediments represent basin floor deposits, interbedded chalk and turbidites, similar to those at Site 632. The middle unit, consisting of homogeneous ooze and chalk and occasional debris flows is tentatively interpreted as a series of slumps. Seismic data support the presence of at least three generations of slumps within the upper 300 m at this site. The topmost unit consists of 52 m of ooze with thin turbidites, draping the topographic high created by the middle unit. Abundant bank-derived aragonite is present, ascribed again to very high rates of deposition (up to 115 m/my in the late Miocene-early Pliocene).

Exuma Sound, Landward Site

Site 631

Site 631 was located on the steepest (10-12 degrees) part of the gullied upper slope, where by-passing of bank-derived material should be most pronounced and sedimentation rates slow. The major surprise was that, although coarse sediment bypassing is occurring, and sandy turbidites were virtually absent in the 244 m of periplatform ooze and chalk penetrated, sedimentation rates of this perennial "background" sediment were as high as 75 m/my.

Seismic data, in conjunction with the drilling results, suggest that at least this part of the "by-pass" slope is prograding very slowly basinward with time, presumably as a result of a slow creep and small-scale slumping.

Within the Neogene/Quaternary sections at all of the Exuma Sound sites, the organic content, presumably derived from the sea grass Thalassia, appears to be significantly higher than at other locations in the Bahamas. This increase correlates with anaerobic oxidation, both by the processes of sulfate reduction and methanogenesis. Byproducts of these reactions are responsible for the greatly enhanced cementation of shallow subsurface sediments in Exuma Sound, yet they do not alter the interstitial pore waters to dissolve all aragonite, which persists to the bottom of the sampled sections at all locations.

CONCLUSIONS

Leg 101 answered many questions, but left others open for further study. For example, the presence of a drowned mid-Cretaceous "megabank" in the northern Straits of Florida/southern Blake Plateau seems reasonable based upon results from Site 626 and 627, but the drowning process may have been diachronous, as indicated by a comparison of results at Sites 627 and 635. Faulting probably influenced the subsidence patterns, as suggested by the more than 2 km difference in elevation between the sampled platform top at Site 627 and the inferred one at Sites 635 and 636. However, the bank margins do migrate laterally at least tens of kilometers through time (Site 626/Great Isaac-I), and this argues against significant fault control of the modern bank-trough configuration.

"Highstand shedding" by carbonate platforms is supported by the Leg 101 slope transects, particularly in Exuma Sound. By-passing is an important process on both the gentle slopes of LBB or the steeper slopes of ES, but rates of deposition remain high even on the steep slopes. These high rates support both rapid lithification and burial of organic matter.

Leg 101 has added a dimension of earth history to the numerous studies on modern platform flanks. For one, the modern sediments of the Bahamas, often used as a standard for the interpretation of the geologic record, have provided the key to their own past. This past is more varied and turbulent than previously believed. Periods of crisis and of rapid expansion figure prominently in addition to intervals of steady growth. These changes seem to be governed by a complex interplay of oceanic productivity, eustatic sea level fluctuations and tectonics that we have barely begun to document and understand.

REFERENCES

Benson, W.E., Sheridan, R.E. et al., 1978, Initial Reports of the Deep Sea Drilling Project, 44: Washington (U.S. Govt. Printing Office).

Mullins, H.T. and Lynts, G.W., 1977. Origin of the northwestern Bahama platform: review and reinterpretation. Bull. Geol. Soc. Amer. 88: 1447-1461.

Mullins, H.T. 1983. Comment on "Eustatic control of turbidites and winnowed turbidites." Geology 11: 57-58.

Schlager, W. 1981. The paradox of drowned reefs and carbonate platforms. Bull. Geo. Soc. Amer. 91: 197-211.

Schlager, W., Austin, J.A., Jr., Corso, W., McNulty, C.L., Fluegel, E., Renz, O., and Steinmetz, J.C., 1984. Early Cretaceous platform re-entrant and escarpment erosion in the Bahamas. Geology 12: 147-150.

Shanmugam, G. and Miola, R.J., 1983. Reply to "Comment on 'Eustatic control of turbidites and winnowed turbidites'". Geology 11: 58-59.

Sheridan, R.E., Crosby, J.T., Bryan, G.M., and Stoffa, P.L., 1981. Stratigraphy and structure of souhern Blake Platform, northern Florida Straits, and northern Bahama Platform from multichannel seismic data. Bull. Amer. Assoc. Petrol. Geol. 65: 2571-2593.

Thiede, J.. 1981. Reworked neritic fossils in upper Mesozoic and Cenozoic central Pacific deep sea sediments monitor sea level changes. Science 211: 1422-1424.

Vail, P.R. et al., 1977. Seismic stratigraphy and global changes of sea level. Memoir Amer. Assoc. Petrol. Geol. 26: 49-212.

Table 1. Summary of Leg 101 drilling.

Hole	Dates (1985)	Latitude	Longitude	Water Depth*	Penetration	No. of Cores	Meters Cored	Meters Recovered	Percent of Recovery
626A	31 Jan.- 1 Feb.	25°35.08'N	79°32.73'W	846	12.8	2	11.4	5.0	44
626B	1 Feb.- 3 Feb.	25°34.87'N	79°33.08'W	846	184.5	5	47.5	13.9	29
626C	3 Feb.- 4 Feb	25°36.02'N	79°32.80'W	849	179.3	19	179.3	65.5	36
626D	4 Feb.- 9 Feb.	25°36.02'N	79°32.81'W	849	456.3	28	276.9	8.9	3
627A	10 Feb.-10 Feb.	27°38.10'N	78°17.65'W	1029	8.8	1	8.8	9.5	107
627B	10 Feb.-17 Feb.	27°38.10'N	78°17.65'W	1025	535.8	60	535.6	344.2	64
628A	17 Feb.-19 Feb.	27°31.85'N	78°18.95'W	966	298.4	32	298.4	216.9	73
629A	19 Feb.-20 Feb.	27°24.39'N	78°22.10'W	553	16.5	3	16.5	6.2	38
630A	20 Feb.-21 Feb.	27°26.94'N	78°20.43'W	807	250.3	26	250.3	220.3	88
630B	21 Feb.-21 Feb.	27°26.94'N	78°20.43'W	807	80.4	9	80.4	79.6	99
630C	21 Feb.-21 Feb.	27°26.94'N	78°20.43'W	807	9.3	1	9.3	9.3	100
631A	23 Feb.-25 Feb.	23°35.20'N	75°44.56'W	1081	244.3	25	244.3	159.0	65
632A	25 Feb.-26 Feb.	23°50.44'N	75°26.13'W	1996	141.0	16	141.0	83.3	59
632B	26 Feb.- 1 Mar.	23°50.44'N	75°26.13'W	1996	283.2	17	162.6	34.8	21
633A	1 Mar.- 2 Mar.	23°41.31'N	75°37.41'W	1681	227.3	24	227.3	110.8	49
634A	3 Mar.- 8 Mar.	25°23.02'N	77°18.88'W	2835	479.4	32	322.5	27.3	9
635A	9 Mar.- 9 Mar	25°25.13'N	77°19.92'W	3448	20.1	3	20.1	6.2	31
635B	9 Mar.-11 Mar.	25°25.13'N	77°19.98'W	3470	117.1	14	117.7	31.2	26
636A	11 Mar.-13 Mar.	25°25.11'N	77°18.35'W	3573	21.0	2	21.0	0.1	0.5

*sea level; corrected m, echo-sounding

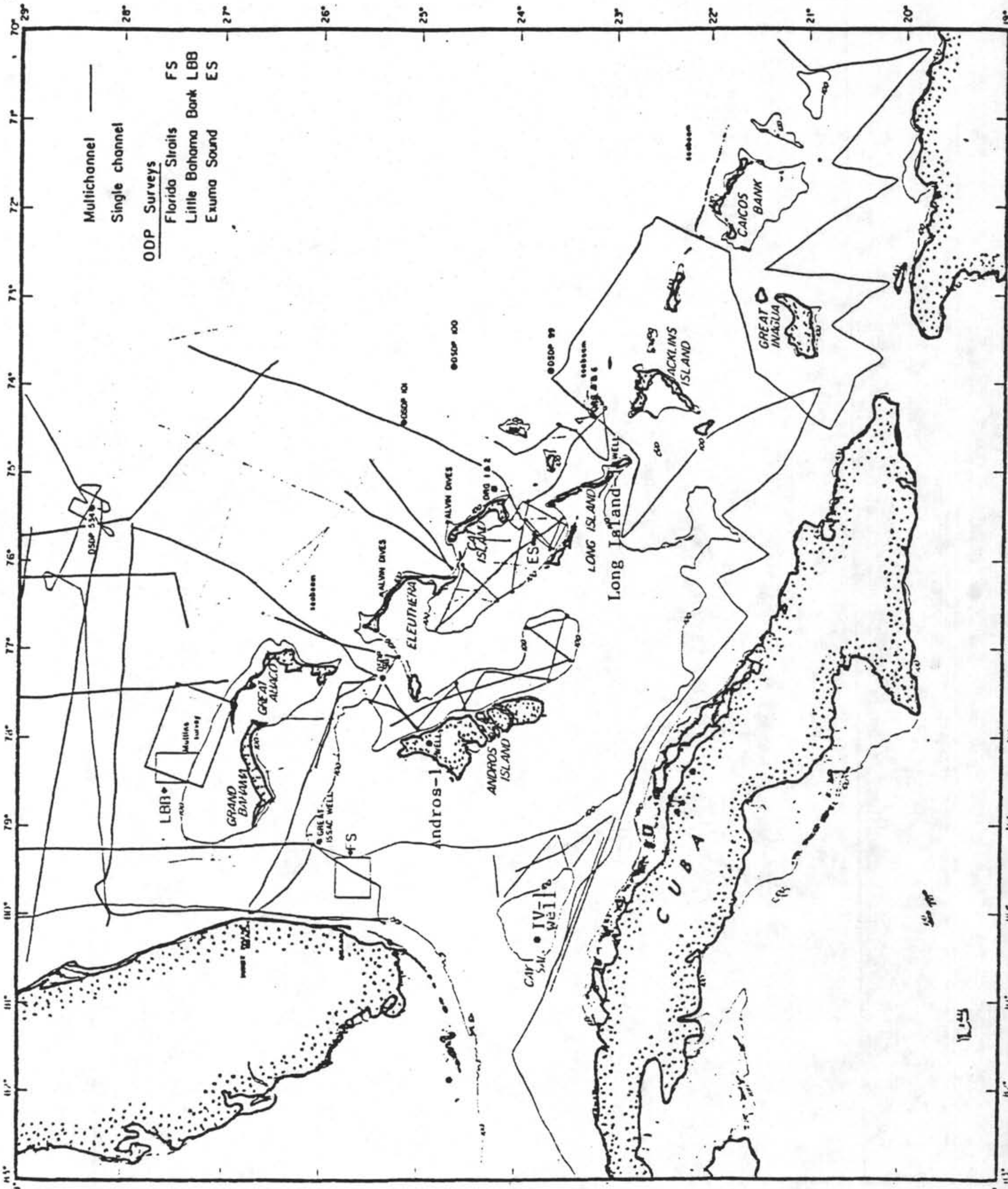


Figure 1. Map showing location of target areas for Leg 101: Little Bahama Bank (LBB), Straits of Florida (FS) and Exuma Sound (ES). Details of these areas are shown in the trackline maps in figures 2, 3, and 4. Previously drilled DSDP sites and deep stratigraphic tests are also indicated.

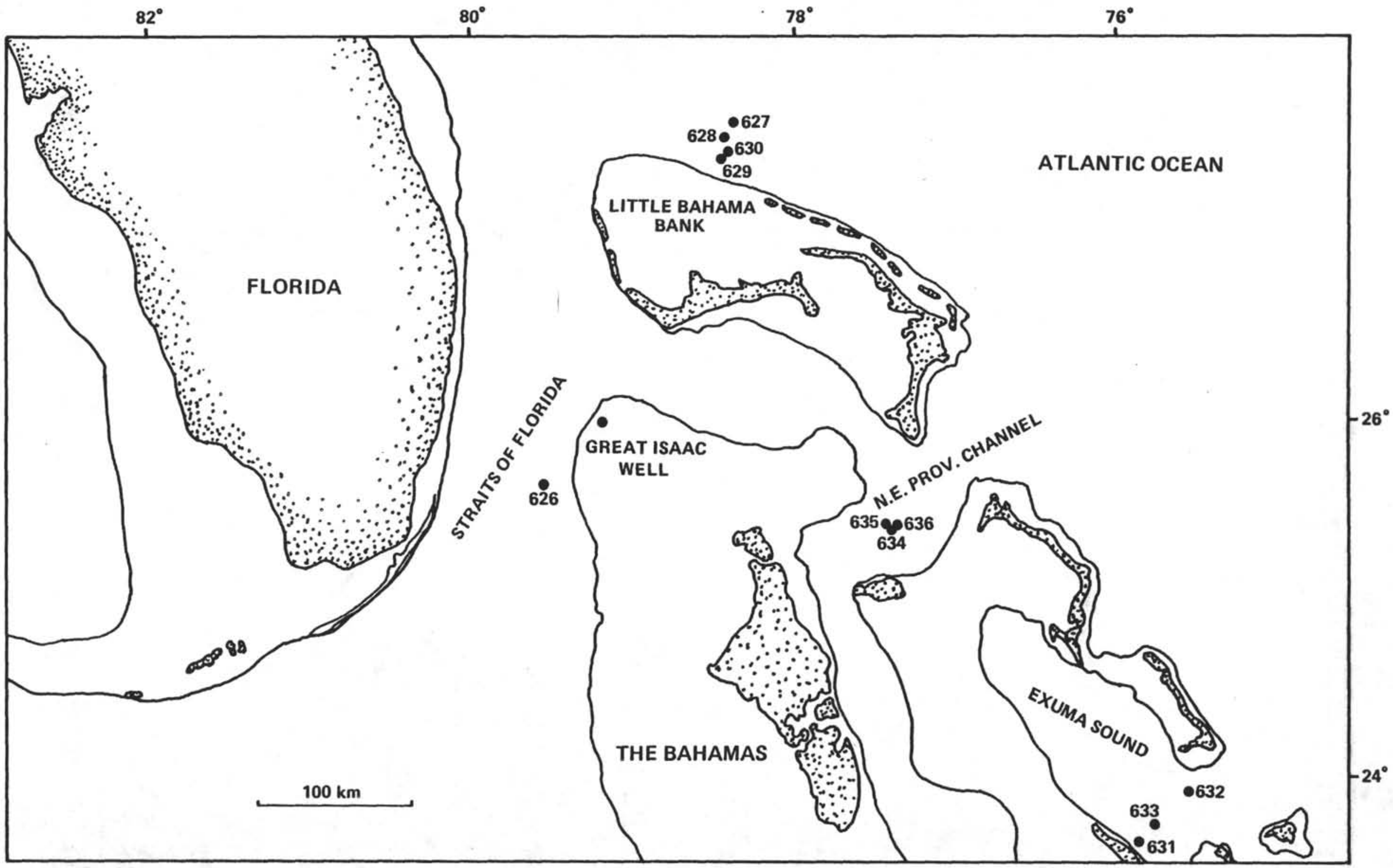
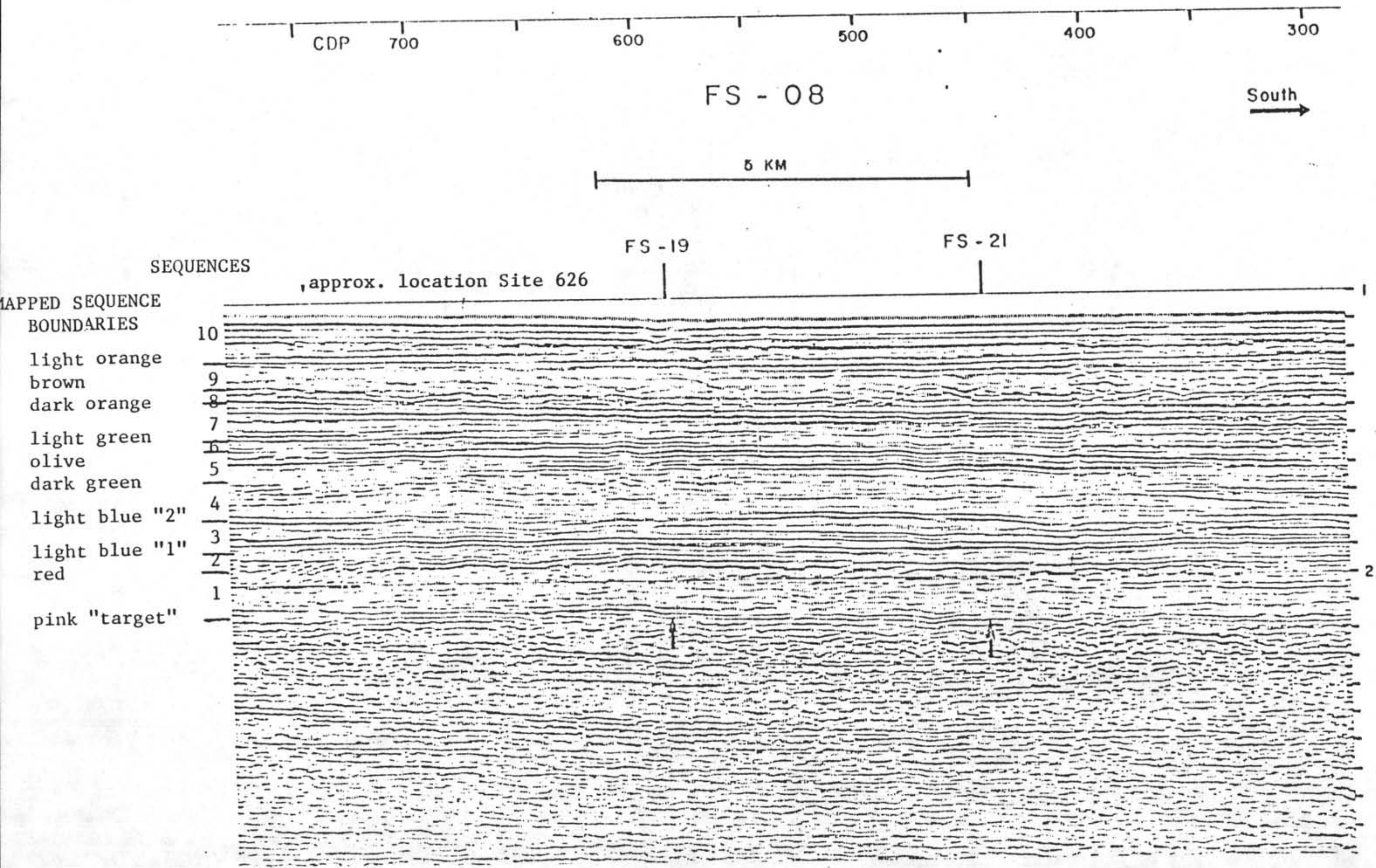


Figure 2. Location of sites occupied on Leg 101.



Target horizon indicated by arrows

Figure 3. Sequences and sequence boundaries identified and mapped in the vicinity of Site 626.

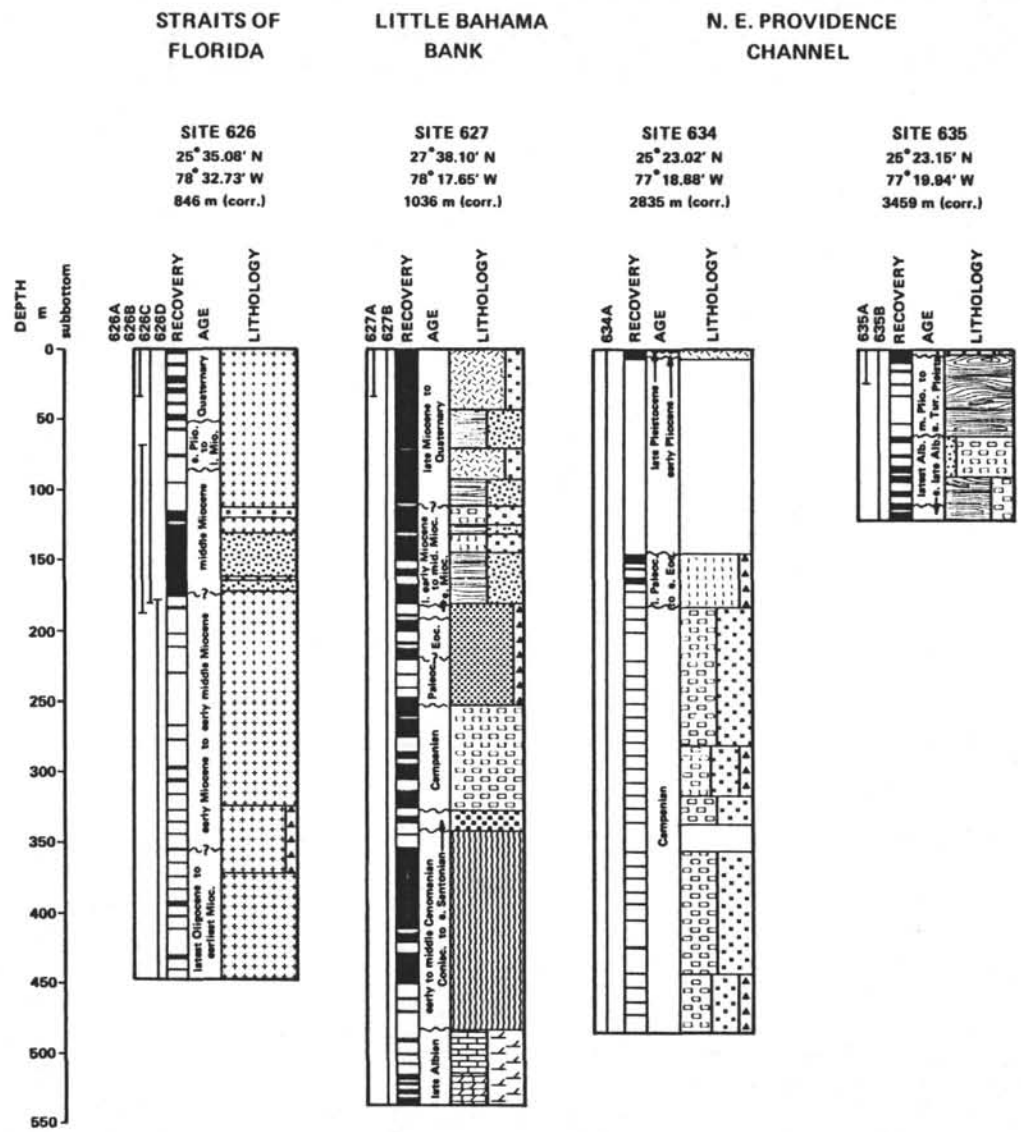


Figure 4. "Deep objective" sites, Leg 101. (Lithological symbol key appears in Figure 5).

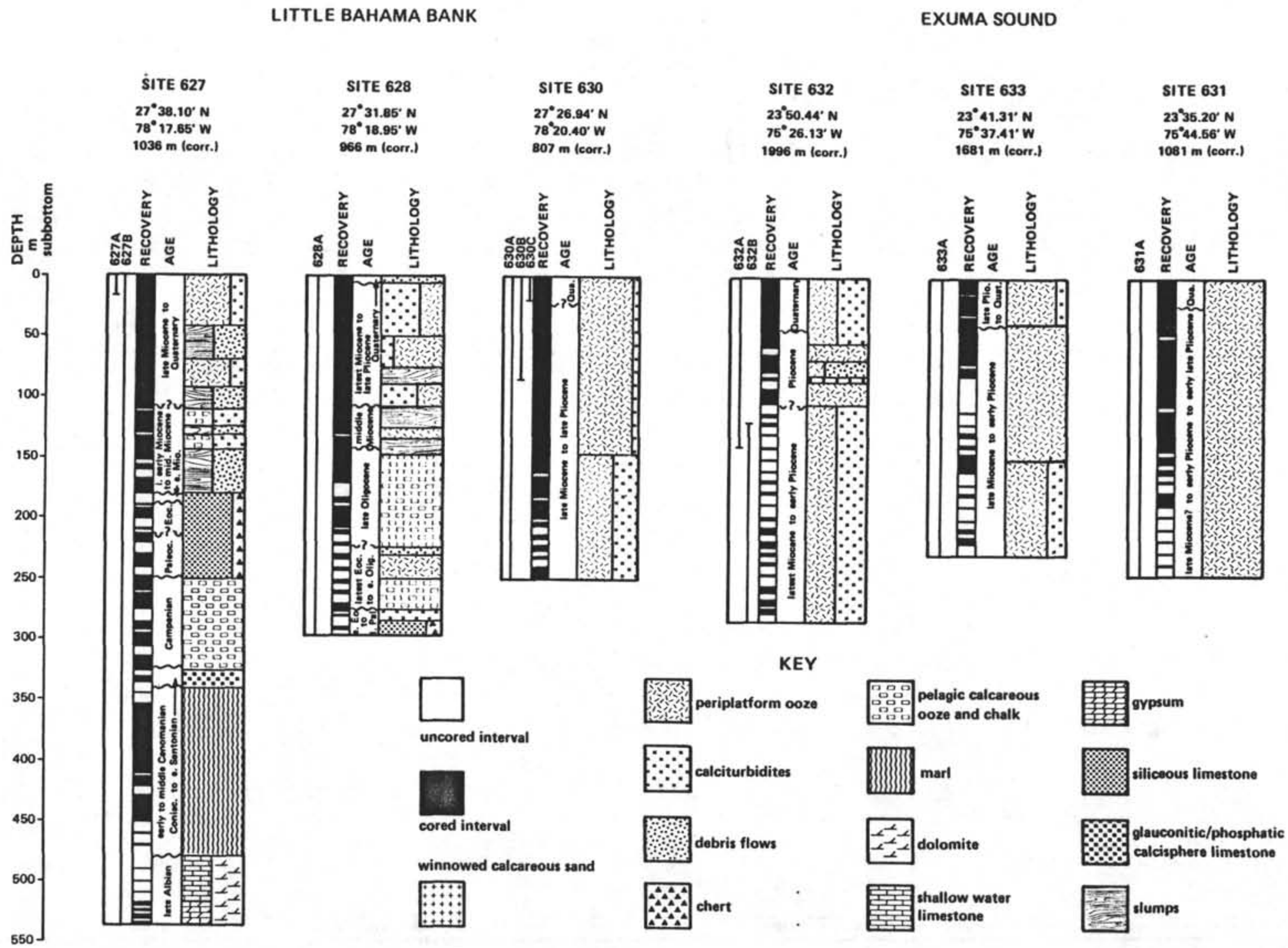


Figure 5. "Shallow objective," slope transect sites, Leg 101.

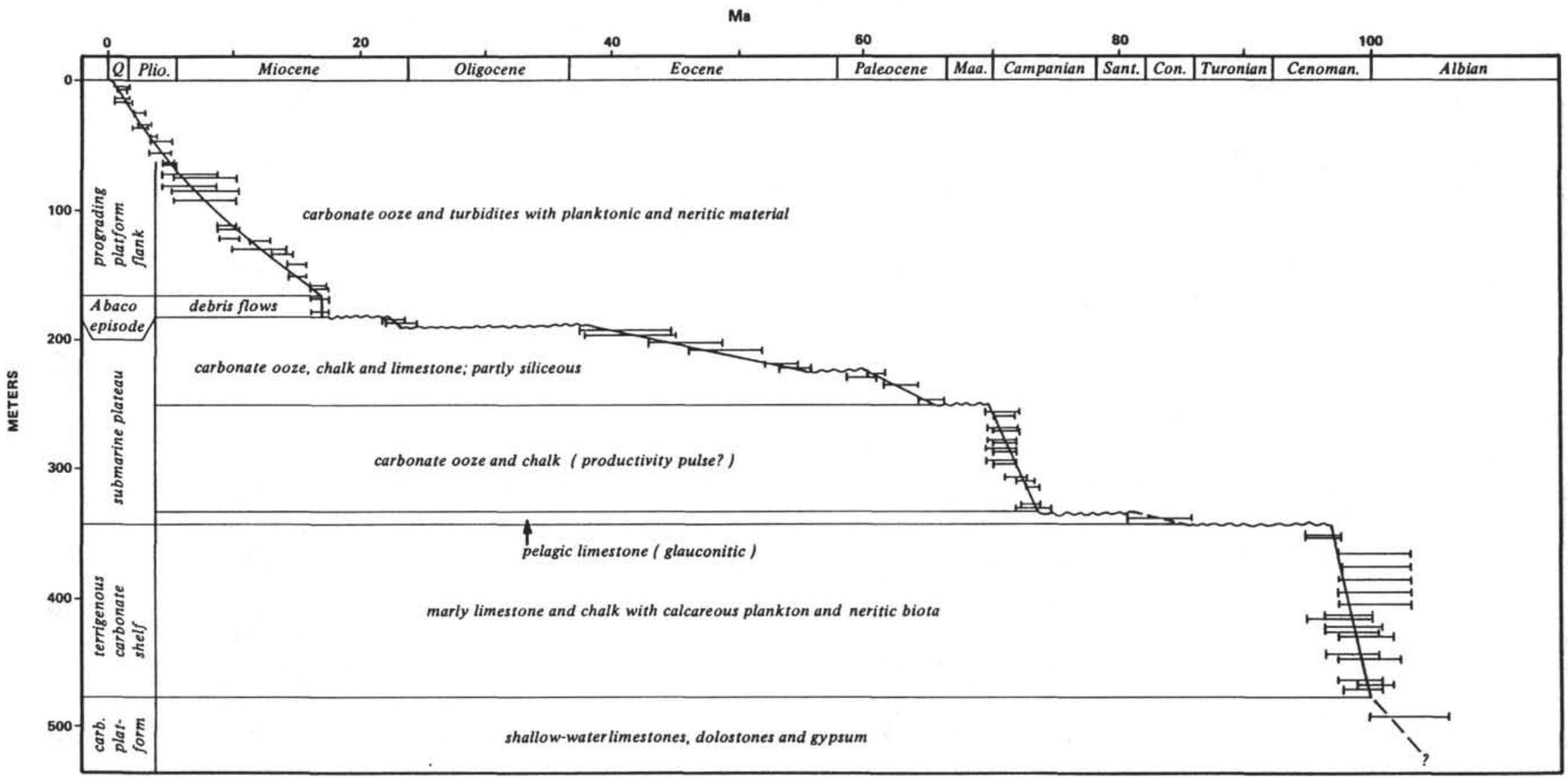


Figure 6. Age-depth curve and geologic history of Site 627 on southern Blake Plateau. Drowning of carbonate platform during mid-Cretaceous crisis is followed by partly terrigenous deposition on a shelf, and by 80 Ma of slow pelagic deposition on a submarine plateau. In the last 20 Ma, the area has come under the influence of the prograding Bahama platform again. "Abaco episode" refers to a widespread incidence of debris flow deposition in the middle Miocene first documented in the Blake-Bahama basin during DSDP Leg 44 (Benson, Sheridan et al, 1978).

TECHNICAL REPORT

The ODP Technical and Logistics personnel aboard JOIDES RESOLUTION for Leg 101 of the Ocean Drilling Program were:

Laboratory Officer:	Ted "Gus" Gustafson
Laboratory Officer:	Dennis Graham
Curatorial Representative:	Robert Hayman
System Manager:	William Meyer
System Manager:	Daniel Bontempo
Chemistry Technician:	Bradley Julson
Chemistry Technician:	Tamara Frank
Electronics Technician:	Randy Current
Electronics Technician:	Dwight Mossman
Yeoperson:	Wendy Autio
Photographer:	Roy Davis
Marine Technician:	Larry Bernstein
Marine Technician:	Mark Dobday
Marine Technician:	Henrike Groschel
Marine Technician:	Harry "Skip" Hutton
Marine Technician:	Jessy Jones
Marine Technician:	Mark "Trapper" Neschleba
Marine Technician:	John Weisbruch

LEG 101
ODP TECHNICAL REPORT
SUMMARY

Leg 101 commenced January 31, 1985 following Leg 100 Shakedown activities and a 2 day port call in Miami. The overall scientific objectives for this first ODP cruise were to study the structural and stratigraphic evolution of the Bahamas Carbonate Platform. Nineteen holes were drilled in 4 distinct areas of operations at eleven site locations. Over 1500 meters of core was recovered using APC, XCB, and conventional rotary coring methods. Over 7400 samples were collected for shipboard and shore based analysis. Logging was attempted in 3 holes. Underway geophysical data was collected on most transits between areas of operation. Leg 101 was terminated on 14 March 1985 in Miami after 43 days at sea.

Miami Portcall

Portcall activities included routine logistic support functions, technician crossover and crew change. In port local purchases were unusually broad in scope. This was to be expected with a new program of this magnitude. In port purchase levels will reduce to normal or near normal levels before leaving U.S. ports. Technical representatives were on hand to help service the following laboratory equipment: Scanning Electron Microscope, Zeiss Microscopes, and X-ray Diffraction unit. A service representative from Photo Lab Fabricators completed installation of remaining cabinet work in the Photo Lab. Several reporters were given tours of the ship by ODP administrative and technical personnel.

<u>Cruise Activities</u>

The Florida Straits, Little Bahama Bank and Exuma Sound were selected as Leg 101 operational areas. Drilling activities in these areas was an overall success despite the fact that not all scientific or drilling goals were achieved. In the Florida Straits strong bottom currents which affected dynamic positioning acoustics and sandy hole conditions precluded reaching deeper scientific objectives. Drill pipe and bottom hole assemblies were lost on 2 of the 4 holes drilled in the Straits. Gamma Ray Logs were run in Hole 626D. The Bahama Bank Sites were somewhat troublesome. Hydrocarbon shows and poor hole conditions forced early abandonment of several holes. Logging attempts in Hole 627B were unsuccessful. A Natural Gamma Neutron logging tool was stuck in the hole after penetrating a bridge. Attempts to retrieve the tool were unsuccessful and the wireline parted. Fishing attempts were also unsuccessful and the hole abandoned with heavy cement and mud plugs. Scientific objectives were realized in 2 of the 6 holes in this area. In the Exuma Sound 4 holes were drilled at 3 site locations. Drilling at 2 sites was terminated for scientific reasons. Hydrocarbon shows terminated drilling at 1 site. Due to the early unplanned abandonment of drilling operations in the 3 primary areas of operation, sufficient time was available for drilling operations in the

Northwest Providence Channel. Hole 634A was drilled near DSDP Hole 98. Drilling was terminated prior to reaching "megabank" objectives. Logging at this site was restricted to Compensated Neutron and Gamma Spectroscopy tools which could be run in the pipe. Poor hole conditions precluded running tools outside the pipe. Attempts to reach "megabank" objectives at the next site also were unproductive. Hole 635A was terminated quickly due to rubble. Hole 635B was abandoned after flowing sands stuck the core barrel in the BHA necessitating pulling out of the hole. A third site was selected and Hole 636A was spudded. Due to time constraints and poor recovery drilling was terminated and the pipe pulled for the last time on Leg 101.

Numerous personnel transfers were made by helicopter and boat throughout the cruise. Miscellaneous supplies, equipment and mail were also transferred.

Laboratory Operations

Overall laboratory operations were remarkably successful considering that the laboratory facility and most equipment and personnel are new. All areas require various degrees of improvement ranging from simple procedural concerns, lack of appropriate spares and personnel inexperience to major problems with basic physical plant services in the lab stack and unsuitable sonar equipment or equipment location.

Core laboratory operations were normal. We anticipate the need to possibly improve core box quality. Present boxes absorb moisture and do not appear sturdy enough for repeated handling.

The core splitting table will require fiberglassing for additional protection against moisture and other abuses. Minor improvements to the core splitter and water supply for the super saw are also necessary. In the physical properties area shear wave velocity transducers are inadequate. Replacement transducers should be considered. We expect that the thermal conductivity needle probes will require replacement in the near future. We have no spares. Minor software changes to the thermal conductivity computer program are also suggested. The core extruder hydraulic ram was returned to ODP for overhaul and modification. The core prep deck grating outside the core lab is a mud collector which is difficult to keep clean as presently configured. We are suggesting that the solid grating be replaced with open grating and that a suitable drain pan be installed under the grating. This will help aid in reducing mud contamination which is tracked into both the laboratory and superstructure. It will also reduce the amount of mud which is presently washed on to the main deck and casing hold hatch.

Several areas of concern have developed in the Paleontology laboratory. It is suggested that the microscope vibration stands be redesigned to raise the microscope 2"-4" and also allow for proper light installation. The acquisition of additional microscope components has been suggested by Leg 101 scientists. The present sink size is too small for easy sieve washing of samples. Additional desk, counter and storage space has been requested.

The XRD laboratory was used extensively. Minor mechanical problems with the XRD unit were experienced throughout the cruise. Software problems were a major concern and as of yet the true cause is yet undetermined. Prime suspects are high lab air temperatures and A.C. power. During a major power outage the X-ray tube failed most likely due to a power surge associated with the outage or by shutdown of the cooling system.

The SEM worked well for most of the cruise. High lab air temperatures and high diffusion pump cooling water temperature initially caused difficulty in obtaining sharp images at settings higher than 300X. The water temperature problem was eliminated by plumbing the unit into the heat exchanger system used by the XRD and completely bypassing the air cooled pump unit which was recommended for the XRD. It will be necessary to disconnect the SEM from the XRD heat exchanger when the XRF unit arrives. A suitable heat exchanger unit for the SEM has been ordered. The lab air temperature problem has not been resolved. Other minor problems with the SEM were resolved as operator experience increased.

The Chemistry laboratory experienced a very heavy work load. Problems were experienced with all equipment in this lab at one time or another. Due to the heavy work load trouble shooting was at time difficult. Most problems were resolved, however several persist. On the Rock Eval unit total organic carbon data is non-reproducable and always too high. This problem was compounded due to the C.H.N. Analyzer not being operational until late in the cruise. The Rock Eval unit requires further trouble shooting. The H.P. 86B computer has software and memory problems which require tech rep. assistance and possibly hardware changes.

JAX, the shipboard computer system functioned extremely well and was extensively used by both the scientific and technical teams. System capabilities will be added as developed. Those CSG application programs presently in use which are not fully implemented can be expected to be so within the next several cruises. Considerable effort was made to organize all documents and technical literature. A shipboard system manager operational handbook was compiled. Tutorial materials and instructions for system users were also compiled. Classes were held for those interested in using the computer system. It is hoped that the shipboard computer facility and support personnel can maintain a high degree of flexibility in support of shipboard data collection and user requirements. During the cruise 2 hardware failures occured. The first problem was isolated to an interaction between FP-750 and MIC boards. After changing out boards the system was made operational. The second failure occured as a result of a power outage. Two tape drives were damaged. One of the tape drives was made operational and the other requires DEC maintenance in Miami. Several other failures occured during the cruise including several PRO monitors, printer, 2 system units, a PRO motherboard and power supply. These items also require service in Miami.

The workload in the Photo Lab was heavy. It was necessary to limit close up work for scientists to that which was essential for reports. The potable water supply to the lab is contaminated by particulate matter and at times we suspect the presence of oil or grease. The present filtration units are not adequate for present needs.

Water dripping from HVAC Ducting in the Second Look Lab has rendered this area virtually useless until the problem can be resolved.

Underway time was minimal during the cruise, however several problem areas have become apparent. Both the 12 KHz and the 3.5 KHz sonar systems appear to have problems with either power out or input sensitivity. The records become saturated with noise and the return signals are weak even in relatively shallow water at ship speeds over 5 knots. We have serious reservations concerning their usefulness as presently configured for deep water work. We suspect the transducer location or efficiency of the elements or cabling may be at fault. Both magnetometer sensors were also troublesome. One sensor has leaked on several occasions causing erratic readings. The other sensor has a high resistance short to armor. This sensor is being returned to vendor for repair. The leaking sensor is thought to be repaired and will remain on board. The Masscomp Digital Seismic System works well at ship speeds up to 8 knots. Above this speed error messages appear and soon the computer crashes. This problem seems related to power and shaft RPM's. The pit log needs to be calibrated. Zero setting can be done dockside in port, however the full scale settings can only be accurately made while running the ship thru the measured mile a minimum of three times. Underway time was minimal this cruise. Geophysical lab watch standing procedures require improvements that we feel will occur within the next several cruises as more experience is gained collecting Underway Geophysical data. This applies both to Geophysical Lab watch standers and SEDCO bridge personnel. Precise navigation and fix positioning is essential to good geophysical data collection. The reliance on third party equipment and personnel results in less than optimum data collection. We believe these functions could be better performed with ODP equipment and personnel in the Underway Geophysics Lab. Cable level winding on the streamer winches was troublesome at times. Especially with beam seas, wind or current. Platforms aft of the winches at the poop deck elevation are scheduled to be built. These should make level winding easier. They will also reduce the time required to attach and remove cable leveling "birds" from the streamer. We will explore the possibility of retrofitting the streamer winches with cable level winding apparatus if budgets permit. A 400 cubic inch water gun was deployed on 2 occasions this cruise. Towing speeds ranged from 5 to 9 knots. Depending on sea conditions the gun tail buoy will submerge thru short choppy seas and appear to "skip" thru the water at speeds over 7 knots. We lost a tail buoy due to this "skipping" action. We recommend limiting towing speed when using the 400 cubic inch gun to 6 knots until a suitable high speed towing rig can be designed and tested.

A list of laboratory deficiencies was compiled during Leg 100 and given to ODP and SEDCO Management. Many of the minor concerns were attended to during Leg 101. Major problem areas and concerns that still require attention are as follows:

A. Inadequate ventilation of Foc'sle Deck.

B. Excessive vibration from fume hood exhaust fans.

C. Air in lab stack water lines.

D. Water from HVAC Ducting in Second Look Lab flood area.

E. Lab Stack floor drains do not drain adequately.

F. Development of casing hold for gym and storage facilities

G. Provide dedicated communication from Poop Deck and U/W Geophysical Lab to Bridge.

H. Voltage fluctuations noted in back up regulated power supply service to lab stack.

I. Voltage spikes noted in regulated power supply service to U/W Geophysics Lab.

J. Power "brown out" 24 February 1985.

These major problem areas and concerns will require review by ODP and SEDCO management to determine cost effective means for solving these problems. With regard to problems noted with laboratory equipment and procedures it is reasonable to expect that given time, spare and experience many of our minor concerns will improve.

Storekeeping

A concentrated effort was made to organize, stow and inventory all supplies put aboard in Pascagoula and Miami. The key entry of inventory information into "MATMAN" materials management database was started. Only a part of the overall

"MATMAN" program was available for Leg 101 use. Leg 102 will continue with this work and hopefully by Leg 103 the complete program will be initialized and put into full use.

Safety

ODP has been invited to participate with SEDCO in their safety meetings. It is apparent that both SEDCO and ODP personnel must work together to develop comprehensive emergency procedures and plans for the lab stack. Tentative plans have been started. We believe it essential that our technician team be given fundamental training in the near future; during their time off in the following areas if any emergency plan is to be successfully implemented: basic firefighting, use of Scott Air Packs and O.B.A. devices, basic first aid and C.P.R. Shipboard efforts are presently being made to build upon these basics and augment with basic lifeboat launching procedures and operation to detailed familiarization with general shipboard emergency equipment and procedures.

OPERATIONS RESUME

The ODP Operations personnel aboard JOIDES RESOLUTION for Leg 101 of the Ocean Drilling Program were:

Cruise Operations Manager:	Lamar Hayes
Supervisor of Drilling Operations:	Barry Harding
Special Tools Development Engineer:	Dave Huey

OCEAN DRILLING PROGRAM
TEXAS A & M UNIVERSITY/JOIDES
OPERATIONS RESUME
LEG 101

Leg 101 was the first scientific voyage of the "Joides Resolution" (officially the Sedco/BP471), a dynamically positioned drillship operating under the auspices of the Ocean Drilling Program. The Program, a successor to the fifteen-year Deep Sea Drilling Project, was intended to further the knowledge of the world's oceanic geology by coring and data taking in a series of expeditions worldwide. The techniques perfected on the Glomar Challenger during DSDP were coupled with the improved capabilities of the newer drillship to produce an unparalleled tool for scientific research in the deep ocean. Leg 101 was both a continuation of the ongoing effort begun during DSDP and a test of the newly modified ship and its systems.

The vessel underwent major modifications during a 137 day overhaul and drydock period in Pascagoula, Mississippi. Significant improvements were made to the shipboard drilling systems including addition of: a new Varco electric top drive, an iron roughneck, dual elevator system, Western Gear in-line heave compensator, improved drawworks, dual drum coring winch, a pipe racker addition to accommodate 8500 feet of 5-1/2" drill pipe, and a 250 ft. radius guide horn extending from the rig floor to the keel. Other major modifications to the ship included installation of a seven story lab structure module housing core handling and inspection labs, core storage reefers, a computer center and a plethora of sophisticated laboratories for shipboard analysis of cores.

The ship departed Pascagoula on January 11, 1985 and spent 18 days at sea for shakedown and crew training in the Gulf of Mexico and the Straits of Florida. Leg 101 officially began when the vessel made port in Miami, Florida with the first line over at 1040 hours on January 29, 1985. The leg ended in Miami with the first line across at 0615 hours on March 14, 1985. During the voyage the vessel transited 898 nautical miles during the voyage, occupied 11 sites, and cored 19 holes. The cruise lasted 43.8 total days of which 2.25 days were spent in port, 5.3 days were spent in transit and 36.3 days were spent on site.

Leg Objectives

The inaugural voyage of the Ocean Drilling Program was intentionally chosen to be one in which the areas of operation would be close to U.S. ports in the event of major problems with any of the new or overhauled shipboard systems. As it turned out this precaution proved to be unnecessary.

The scientific objectives of Leg 101 were determination of the development of the Bahamas carbonate platform. The investigation was to be carried out by coring at sites located in three regions in and around the Bahamas; a deep hole in the Straits of Florida, a trio of sites in a transect across the Little Bahama Bank, and another three hole transect in Exuma Sound with one hole being a deep penetration. Upper soft sediments were to be piston cored followed by Extended Core Barrel coring to selected target depths less than 300m and the deep penetration holes were to be logged under the guidance of Lamont-Doherty, the science operator for logging and downhole instruments.

First Miami Port Call

The vessel remained in the port of Miami for 2.25 days during which a partial crew change by both Sedco and ODP personnel was accomplished, supplies and provisions were on-loaded and the Leg 101 scientific party was boarded. Shipfitters and Sedco personnel worked around the clock to complete unfinished work left over from the shipyard as well as correct specific discrepancies identified during the shakedown cruise. Major work items accomplished during the brief but hectic port call were:

- Repair of stripped drawworks drive line
- Repair of propulsion motor
- Making up drill pipe from the casing hold into stands for storage in the pipe racker
- Making up drill collars for vertical storage in the derrick
- Filling of mud pits and tanks with drill water
- Tours for guests and members of the press

Transit to Site 626

The ship departed Miami at 1620 hours on January 31, 1985 with 115 personnel aboard and made a very short trip to Site 626 in the Straits of Florida . The site number was assigned in continuation of the sequence of numbering of the sites of the Deep Sea Drilling Project. (Leg 101 followed the shakedown cruise which was arbitrarily designated Leg 100 although the final voyage of DSDP was designated Leg 96.)

Site 626 (BAH-1C) - Straits of Florida

The ship arrived on site and dropped a beacon at 2205 hours on January 31st. The site alternatives had been occupied during the shakedown cruise during which the level of current in the Gulf Stream had been determined to be severe enough to abandon plans for setting a re-entry cone to enable a multi-bit attempt at achieving deep penetration up to 1350 meters BSF. Site 1C had been determined to present the best opportunity for a single bit attempt to reach the target depth with positioning difficulties and drill string stress expected to be poor but tolerable. Currents at the site were estimated to be up to 2 knots as compared to sites 1A & B where currents up to 4 knots were encountered.

A new RBI-manufactured core bit was made up to a hydraulic bit release and a bottomhole assembly composed of 11 drill collars. While running in the hole the first beacon apparently died and a second was quickly dropped. Steady on the new beacon the pipe trip continued with significant pounding of the drill string on the guide horn caused by current drag and vortex shedding but the effects diminished to tolerable levels after the BHA approached the sea floor.

Hole 626A

This hole was spudded at 1130 hours February 1st in 858.5m of water. The bottom was very firm and required up to 2000 lb. of delicately applied WOB to cut the first core and bury the first drill collar. Core 1R was recovered with 1.44m of loose coral sand and fragments ranging in size from grains to ping pong ball size chunks. Core 2R was tediously cut requiring one and half (1 1/2) hours and probably would not have been possible with a good heave compensator. The second core contained fine coral sand. While pumping the third core barrel down the bit was found to be plugged. The core barrel was jammed when recovery was attempted and it was finally retrieved with some difficulty. Circulation was reestablished and coring operations were resumed when the vessel lost its beacon signal and took a 200-400 foot excursion during which the pipe pulled out of the hole but apparently without damage to the pipe or BHA. While discussing options on how to deal with what appeared to be a batch of faulty beacons a strong signal from the beacon was discovered some 400-500 feet down current of the original station. The ship was able to maintain station in DP mode at the new location.

Hole 626B

Core 1R consisted of 4m of mostly fine sand. Cores 2R and 33R had no recovery. The drill string tended to stick while retrieving both core barrels. Several slugs of high viscosity were pumped into the hole to stabilize any flowing sand which may have been causing the problem. While retrieving Core 5R the sinker bars parted leaving the core barrel and a portion of the sinker bars in the hole. Another core barrel was fitted with an 8 finger core catcher and used to fish for the parted sinker bars. This was successful after fishing three runs. While preparing core barrel 6R for deployment in the pipe 20 bbls of high vis mud were circulated. The drill bit apparently stuck while rotating the drill pipe at 6-8 RPM. When the top drive was disengaged the drill string "backlashed" and rotated counter-clockwise several turns. A loss of 60,000 lbs was immediately noted on the weight indicator. The fish could not be re-engaged by rotating back down and the drill string was pulled. A total of nineteen joints of pipe and a full BHA (consisting of eleven drill collars and an HBR) were left in the hole.

Hole 626C

A new BHA was made up consisting of a total of seven drill collars including an XCB/APC seal bore drill collar. The XCB was used from spud-in at 855m down to 967m with only 10% recovery. Apparently this 81m section was a very fine, packed sand that made recovery almost impossible. At Core 13 the piston corer was tried in an attempt to improve recovery. Core 14H contained 5m of muddy foraminiferal sand and sand rubble. Cores 15H through 18H had a recovery of 95%. Coring operations were suspended at 1034m and the drill pipe was tripped out of the hole. A rotary coring system was made up and run in the hole in an all out attempt to reach the target at 1000m sub-bottom.

Hole 626D

The hole was spudded in 855m of water with the rotary coring system and a center bit. The hole was drilled without coring to 1033m where continuous coring was initiated. On two occasions hole conditions necessitated pumping 20 bbls of mud to help control sand flow. During the coring operation hole conditions and core recovery both worsened as the hole was deepened. Sand was encountered continuously up to Core 28R. After each one or two joints 10-20 bbls of high vis mud was circulated. Core recovery did not exceed 1.37m in any core - 266m were cored and recovery totaled only 8m (3%). After dropping core barrel no. 29 circulation could not be established and the core barrel could not be engaged when the overshot was run down for retrieval. The sandline was pulled from the pipe and four joints of pipe were laid down as the hole below the bit appeared to be filling with sand. A spare core barrel was rigged as a fishing tool using two 8-finger hard formation core catchers and run in on the sandline in an attempt to recover the core barrel. The retrieval attempt was at first unsuccessful and was continuing when the drill pipe became firmly stuck. Apparently sand had been able to flow into the pipe and accumulate on top of the core barrel. All of the recovery tools showed signs that they had been spudded into sand before reaching the pulling neck on the core barrel.

Drill pipe stretch was calculated with 150,000 lbs of overpull indicating the free point was about 40m above the top of the BHA. A severing charge with 62 pellets of RDX explosives was lowered on the logging cable to a point near the top of the third drill collar above the bit in hopes of freeing the pipe there and saving some of the BHA. Detonation was confirmed but the drill string remained stuck although circulation was reestablished undoubtedly through the severed drill collar. Before a second severing charge could be prepared a Schlumberger logging crew arrived and the logging apparatus was rigged. A gamma ray log was run through the pipe from 1200m to the mud line. Severing charge number 2 was rigged and lowered to 1108m. The charge could not be detonated apparently due to cable head leakage. A third severing charge was rigged and lowered to 1108m and again failed to detonate. Upon retrieval of the logging line the Gearhard-Owens connector was found to have separated leaving the sinker bars and charge in the pipe. Severing charge number 4 was rigged with 31 pellets and lowered to 1048m. Detonation was successful and the pipe came free requiring 75,000 lbs of overpull to clear the 200m of pipe remaining in the hole. The vessel departed from Site 626 at 0815 hours on Feb. 9. The ship cruised at 4 kts for 4-1/2 hours because the No.1 (bow) thruster could not be raised until a faulty hydraulic hose was bypassed by connecting to the hydraulic lines from the No.2 thruster pump.

Site 627

Our second site was located on the Southern Blake Plateau. The coring program was to start coring with the APC/XCB and continuing until the 11-7/16" core bit was worn out, then trip out and return with an RCB system in an attempt to penetrate a target reflector at 1000m sub-bottom.

The beacon was dropped at 0230 hours on Feb.10. The seismic gear was retrieved and the ship positioned over the beacon. The pipe trip in began at 0600 hours. Hole 627A was spudded with the APC from 1036m but a clear mudline could not be established since the core barrel contained a full core. The bit was raised to 1034m and the APC was shot. The core liner was collapsed and the core was destroyed in the removal process. Hole 627B was finally spudded from 1036m with a clear mudline core.

Core barrel 2H became stuck 20m above the bit during retrieval apparently jammed by a piece of shear pin stub. The pin in the overshot was jarred loose at the expense of 300 feet of stranded 9x16 sandline. The damaged line was cut off and a new rope socket was poured on the line. A second core barrel was made up with a bit deplugger and pumped down the pipe at 100 strokes (420 GPM) to impact the stuck barrel and dislodge it. The effort succeeded and both barrels were retrieved on two sandline trips. Core barrel 7H was pulled too high and wedged the sinker bars in the wireline BOP. The top drive tilt was activated to prevent the core barrel from falling down the pipe but in doing so the sinker bars and Spang jars were hung up at the pivot point and severly bent.

On three occasions core barrels became lodged in pipe sections that had just been added to the drill string. The rabbit being used to check internal drift on all of the pipe being picked up turned out to be 0.003 inches under gage. It was replaced and the problem was eliminated.

Core barrel 53X was dropped but never reached the bit according to pump pressure indications. The retrieving tool was lowered and encountered the barrel immediately at the pin end of the top joint of pipe. Efforts to free the barrel were unsuccessful so the sandline was clamped off and cut. The joint of pipe with the stuck core barrel was removed from the string and coring continued. Inspection revealed that two steel balls from the quick release of the wire line wiper had caused the barrel to lodge inside the pipe.

The APC was used very successfully on the first 16 cores with approximately 95% recovery. 75,000 lbs of overpull were required to free the barrel on core 16H so the APC was laid aside in favor of the XCB. XCB core recovery remained very good through Core 47X at 1484m after which recovery dropped off to generally less than one meter per core. The formation consisted of platform carbonates and coarse sand.

Flowing sand began to fill the hole below the bit while retrieving core barrels. Pumping 10 bbls of mud after each core seemed to stabilize the hole. The scientists informed operations that cores 58X and 59X contained traces of oil and 90 ppm methane with traces of ethane and propane thus further penetration was deemed hazardous. Coincidentally the scientific objectives were achieved with the 533m sub-bottom penetration. The hole was conditioned with high vis mud in preparation for logging and the 11-7/16 inch bit was pulled to 1099m. The Schlumberger natural gamma - neutron log was run into the hole through the bit and hit a bridge at 1507m. The tool was spudded through the bridge but could not be worked back up through the tight spot. The tool was lowered to the bottom at 1571m and the hole was logged up to the original tight spot at 1507m. The logging cable was cut and clamped off at the rig floor. The drill pipe was then tediously worked back down to the stuck tool while being stripped over the cable. Apparently the logging tool was pulled free when the bit reached 1486m. The logging cable was retrieved but the logging tool and 40m of cable remained in the hole. The logging cable appeared to have been cut by the bit while working through the bridge. The hole was cleaned out to 1548m in an attempt to push the logging tool to the bottom of the hole. An XCB barrel was dressed with a Larson slip-type hard formation core catcher to be run as a fishing tool for the logging tool. Before lowering the core barrel it was noted that we had a 200 psi increase in circulating pressure and about 2000 lb change in string weight. The core barrel rigged for fishing was lowered and seated at the bit. The fish was engaged but the core barrel could not be freed with the overshot indicating that the logging tool was caught in the slip-type core catcher.

The bit (and probably the logging tool) was raised to 1538m and 150 sacks of cement were pumped in to plug the hole. The bit was again raised to 1099m and 50 bbls of 12 ppg mud was pumped. The pipe was pulled out of the hole leaving the logging tool, most probably under the cement plug.

Site 628

The PDR indicated the water depth to be 973m. A Datasonics 14.5 kHz beacon was lowered to the bottom on the taut line. An APC/XCB coring system was made up and the pipe was run in the hole with a re-run bit used on Site 627. Three water cores were taken with the APC before a pipe tally error was discovered. The APC was used to core to 1167m in chalk and clay with a very good recovery of 89%. When the clay became too stiff for the APC to fully extend the XCB coring system was utilized. The XCB cored 105m and recovered 43% resulting in a total recovery for the hole of 72%. Site 628 was continuously cored to 297m, just 3m short of the projected depth of 300m. After spending a total of 42 hours on the site the drill pipe was pulled until the bit was positioned above the water line in the drill pipe guide.

Site 629

A Datasonics beacon (re-run) was lowered on the taut line to bottom. The same BHA and bit that were used on the previous site were run in the hole. The first APC core was attempted at the mudline, but due to a very firm packed sand the core barrel did not fully extend. With the mud line established at 561m a second piston core with more shear pins was shot and once again the pressure failed to bleed off indicating only a partial stroke. The XCB was then dropped and used to core 2 meters below the mud line at a very slow rate of penetration. The site was abandoned due to lack of sediment for spud in. The drill pipe was pulled until the bit was 100 meters above the mudline and preparations to move to Site 630.

Site 630 - Hole 630A

Departure from Site 629A was delayed two hours because the gears in the winch of the taut wire were stripped. Faced with the dilemma of six hours of down time to repair the winch, an air tugger line was clamped to the 3/8" taut wire and the taut wire weight and beacon were raised clear of the seafloor by 70 feet. The four mile move to Site 630 was accomplished with both the drill pipe and taut wire suspended below the vessel. Upon arrival at the site coordinates the taut wire with the beacon was again lowered to the bottom and the pipe was run in with the same APC/XCB coring tool set-up as used on sites 628 and 629. A piston core established the mudline at 814m and coring continued to 172m BSF with 98% recovery. The chalky formation was ideally suited for piston coring. The XCB was used from 986m to TD at 1064m with 63% recovery. Overall recovery for both coring systems was 87%.

Hole 630B

The scientists decided to double core the upper section of site 630. The APC was used to core to 80m BSF with 99% recovery.

Hole 630C

One mudline core was taken with the APC for curatorial reasons.

Site 631

The site was located three miles south in 1102m of water. Once again the same beacon that was used on the last two sites was lowered and used for positioning. The APC/XCB coring set-up was run in and a mudline core was taken. APC coring continued to 96m BSF with recovery exceeding 99%. The APC was discontinued when the chalk became too stiff to fully extend the core barrel. Coring was continued with the XCB to total depth at 1346m (244m BSF) with 43% recovery. The drill string was pulled from the hole and all drill collar connections were inspected for cracks with dye penetrant

While coring on 631A we had a "brownout" in the electrical system of the ship's lab and hotel. The partial power failure did not affect the ship's positioning or drilling equipment, but did cause some damage to electrical equipment in the labs. The power failure was caused by the crankcase pressure increased and an engine shut itself down without a command from the power management computer. The computer received no signal that Skid No. 2 had dropped off line, therefore no command was given to start another generator to replace the power lost. This problem has since been resolved so that it should not re-occur.

Site 632

The vessel arrived on the proposed site at 0730 hours, dropped the beacon at 4 kts and pulled in the survey gear. After the "burnout" the Sat Nav equipment was giving erroneous positions. At 0830 the co-chiefs determined that the ship was 1/2 mile from the proposed location. The ship was moved the 1/2 mile and a new beacon was dropped in 2006m of water.

The drill pipe was run in the hole with the APC/XCB coring system and a confirmed mudline core established the seafloor at 2006m. Coring continued to 93.5m BSF with the APC recovering 73%. Coring was then continued with the XCB to 141m BSF with 30% recovery. At 2147m the co-chiefs decided to stop coring operations to change over to the RCB coring system.

Hole 632B

The coring tools and BHA were changed out and the pipe was run in the hole and drilled without coring to 2126m (120m BSF). Continuous coring then followed to 283m BSF. Recovery for the 162m cored was only 21%. On cores 10 & 11 it was necessary to flush the hole with 10-20 barrels of high viscosity mud to stabilize what was apparently sand from above. Traces of hydrocarbons (asphalt) were found in core 14. Cores 14 thru 17 had a slight increase of oil stain imbedded in the porous limestone. For reasons of safety Hole 632B coring operations were suspended at 2289m. The bit was pulled to 2148m and the well bore was plugged with 150m sacks of class G cement. The drill pipe was pulled and the vessel was under way to site 633 at 0300 hours on 1 March 1985.

Site 633

The ship arrived at the site after a 10 mile move from Site 632 at 0745 hours. The beacon was dropped and the APC/XCB system was run in the hole beginning at 0830 hours. A piston core was shot and the mudline was established at 1690m. The APC was used to core 83m with 85% recovery. The XCB was picked up and coring continued. Core 9 (APC) and core 10 (XCB) both had no recovery. Cores 11 and 12 had only traces trapped in the core catchers. Coring continued to core 24 at 1918m where coring operations were suspended as scientific objectives had been achieved. With the bit at the bottom of the hole the well bore was filled with 120 barrels of 11 ppg mud. The pipe was then pulled and the vessel was underway for site 634 at 2400 on 2 March.

Site 634

After a 165 mile cruise from the previous site the vessel approached the location of site 634 and the same Datasonics beacon that was used on sites 628, 629, 630, 631 was deployed in 2771m of water. Two and one-half hours were lost replacing an hydraulic line and cleaning a needle on the top drive before running in the hole with the RCB system to 2764m. While feeling for bottom some indication of the mudline was felt at the PDR reading of 2771m but a water core was recovered. The bit was then lowered slowly trying to locate the seafloor by a change on the weight indicator. A positive weight indication placed the mudline at 2863m. The 92m discrepancy had to be solved. The drill collars and pipe were actually measured while running in the hole. The sandline was lowered in the hole until the core barrel was sitting in the bit and the depth counter on the coring line gave the same depth reading as the drill pipe. The final conclusion was that we had a 92m error in the PDR measurement.

Site 634 was a re-drill of DSDP site 98 that was drilled on Leg 11. The mudline was cored with the RCB then the center bit was dropped and the hole was drilled ahead to 3007m (144m BSF). Core 2 was pulled from 3017m with 7.2% recovery. The following 18 core attempts produced no more than few centimeters per core consisting of foram sand, layers of chert, and limestone. The hole was then flushed at intervals with mud to circulate out the sand and chert cuttings. On cores 27 and 28 we washed/cored 19m before retrieving each core barrel. At 3218m the center bit was dropped in a attempt to grind up any chert that was lodging in the throat of the bit and preventing the softer sediments from entering.

After cutting core 31 at 3333m the pipe became stuck while lowering the sand line for retrieving the core barrel. The sand line was retrieved as quickly as possible and the pipe was worked to get free. Circulation was finally achieved with 3300 psi. The pipe came free with an overpull of 125,000 lb. The pipe was pulled to a free zone but the hole remained sticky until the bit reached 3285m. The hole was then cleaned with 40 barrels of high viscosity mud and the core barrel was retrieved. The bit was then lowered back to bottom and only a little fill was encountered. The hole was again flushed with 20 barrels of mud. The drill pipe became stuck again with the bit at the same depth as before at 3333m. The pipe was worked and came free at 125,000 lbs overpull.

The pipe was pulled until the bit was at 3285 and the hole was filled with prehydrated gel mixed with 50% seawater. The logging equipment was rigged to run logs inside the pipe as hole conditions were not considered suitable for open hole logging. Several logging runs were made with a neutron and Gamma Spectroscopy Tool from the bit at 3285m to the mudline. The logs provided detailed information on porosity and basic lithologies that would compensate for the areas of poor core recovery. Logging was completed at 1600 hours on 8 March 1985. The drill pipe was pulled until the pipe was 2300m below the ship. The vessel then moved with thrusters down toward site 635, seven miles away in the Great Bahama Canyon.

Site 635

This site was located near the bottom of the Great Bahama Canyon in 3448m of water. The scientists selected this site because it would require less penetration to reach the platform.

A very firm mudline was encountered with the 9-7/8 bit and required 2000 lbs of weight on the bit to accomplish any penetration. Core 1 consisted of 2.7m of rubble. Core 2 had 3.3m of hard limestone and chert and required 40,000 lbs overpull to raise the bit 9m off bottom. While coring No.3 to 20m BSF the drill pipe would torque up and stall out. The hole was abandoned due to lack of sediment to spud in and very poor hole conditions.

Site 635

The vessel offset from the A-hole 200m upslope. The same bit and coring assembly was lowered to PDR depth of 3444m but had no indication of bottom until 3483m.

The first three cores were slow drilling but on the fourth core the penetration time to core 9.5m was from 10 to 15 minutes. These cores consisted of an assortment of material such as ooze, sand, reefstone, chalk, etc. Core 8 required 68 minutes to drill down. Apparently we had drilled through the rubble section and were coring in firm chalk and limestone. Coring continued without problems for the next few hours as the formation turned to a green marl and the cores were coming in long unbroken sections and had become one of the more interesting holes thus far on Leg 101. To stabilize a troublesome problem of occasional running sand from above, high viscosity mud was circulated about every 18m of new hole.

The overshot failed to engage the core barrel after cutting core 14 from 3600m. The overshot was retrieved and the pin was found sheared. The overshot was redressed and lowered to the core barrel and, again, the pin in the overshot was sheared after engaging the core barrel. The pipe was pulled by doubling out 40m to keep it from sticking; circulation was lost, apparently due to sand packing of around the core barrel. After three more attempts to retrieve the core barrel with various fishing tools the hole was abandoned. The pipe was pulled with the bit plugged causing the drill crews to become drenched in sea water every time a stand of pipe was removed from the drill string. When the last stand of drill collars reached the drill floor we found hard packed sand had completely filled the bottom two drill collars.

The 9-7/8 RBI drill bit was missing cutting ends of all the cones. Even the tungsten carbide teeth were cut as if it had been done in a lathe. The bearings were still tight and no teeth were missing or broken except on the core trimming edge of all cones. Apparently the bit received this damage while drilling chert on Site 634. Probably a piece of chert was pushed down the hole by the bit and literally destroyed the bit before the chert was broken up or side tracked.

Site 636

This site was located near the bottom of the Bahamas Canyon to minimize the penetration depth to reach the platform. The pipe was run in the hole with the RCB to PDR depth of 3575m. The bit was then lowered until a very firm mudline was encountered at 3581m (PDR 3583).

The plan was to drill ahead with the core barrel in place to approximately 50m BSF then start coring in hopes of reaching the platform. The first 5m was either a soft ooze or sand , then the bit encountered something very hard. The drilling problems were identical to Hole 635A. To assist in keeping the bit turning and the drill collars from sticking we cored with 90 strokes (375 GPM) of sea water. Two cores were received while penetrating 21m below the seafloor but only about three inches of very hard limestone were recovered on each attempt. Further attempts to drill Site 636 were abandoned due to lack of sediment to spud in and Leg 101 had no time left for drilling. The pipe was pulled and the vessel was underway for Miami at 1230 hours on 13 March 1985.

Crew Evaluation - Leg 101

By the end of Leg 101 our SEDCO drilling crews were performing coring operations as we had expected. The crews confidence and enthusiasm were reflected in the competitive spirit in that each crew tried to recover more core than the other, however, at the same time they were concerned about core quality. I feel confident that we will continue to see improvement in all SEDCO shipboard personnel. Their efforts on Leg 101 were greatly appreciated.

Special Tools

A Special Tools Engineer was included in Leg 101 to evaluate new or recently modified coring systems, learn shipboard operational characteristics and assist in training the rig crew in use of the ODP coring equipment. This following sections detail the results of special tool usage and problems during the Leg.

Extended Core Barrel (XCB)

The latest version of the Extended Core Barrel, the XCB-101C, was fielded for this Leg. It has several improvements over its predecessors - the most significant of which is a coil compression spring in place of Belleville disc springs. The XCB was used for cores at eight holes. The overall results were at least as good as past versions of the tool. Significant improvements were noted in the Latch, Latch Sleeve, and Cutter Shoes, as well as ease of assembly, on-deck handling and redressing. No routine maintenance problems were observed. The tool can be deemed fully operational after this Leg. The XCB-101B version of the tool, which includes the troublesome Belleville washers, was included on the vessel as a backup but was crated for return to TAMU at the end of the Leg.

During the Miami port call thirteen Cutter shoes were taken to a local machine shop to have out-of-round internal bores fixed so that the Isolation Sleeves could be installed normally. These shoes and others salvaged from the DSDP stock were used extensively during the voyage. The newer version shoes utilize a removable Sleeve which greatly aided in cleanout of the shoes between cores. The 1/16" diameter cross-section O-rings intended to protect against core liner implosion were deleted. The tiny O-rings were very difficult to install without damage. In spite of their removal virtually no liner problems occurred with the XCB. Future versions of the cutter shoes will be designed without the small O-rings and the required tight tolerance that goes with them.

Cutter shoes experienced serious wear on almost all holes where the XCB was deployed. About two shoes per hole were worn to the point that they were retired or required rework. Wear to the cutting structure occurred in chert stringers or when hard sequences of limestone or dolomite were encountered. In general, the wear pattern was a grinding away of 1/2" or more of hardfaced steel saw teeth. Several of the worst cases were rebuilt with Bowen Itcoloy tungsten hardface material and worked quite well.

Acker "amalgamated" synthetic diamond shoes were substituted for the Soft Formation, sawtooth type whenever the formation appeared to be uniformly lithified. These worked as well or better than the soft formation shoes in the harder material plus were significantly easier to clean up between cores. Neither type of shoe proved its ability to exceed about 50% core recovery in lithified formations even under the best of circumstances. Many recoveries were limited to much less than 50%. In every case except when attempting to core loose sand (or coral gravel) the flow ports at the teeth of the soft formation cutter shoes were packed solid with sediment. The design of these shoes is improving but flow to the cutting surface is still highly suspect.

Core recovery varied from well preserved, full cores to zero recovery. The empty cores were all apparently in very loose, sand formations. Good recovery was limited to those types of formations which were stiff enough to retain their trimmed diameter as they entered the core barrel and made their own mud without chips. Firmer material which made hard chips or, more commonly, semi-lithified material which deformed as it attempted to pass the core catchers would almost always result in a core jam in the throat of the cutting shoe or catchers. This phenomenon was alleviated somewhat by the use of soft formation cutter shoes which were built up on the inside of their throats with TC hardface material to trim the core to smaller gage (approx. 2-3/8" or less). On one occasion the core blockages were reduced and recovery increased significantly by increasing bit RPM from 20 to 60. No consistently successful combination of tools or techniques was discovered, however.

Most of one XCB assembly was lost due to a rig floor mishap. A special XCB tool with a slip-type core catcher was used, unsuccessfully, as a fishing tool for a lost logging tool. Upon recovery of the bottomhole assembly the XCB was being removed from the drill collar when a handling clamp broke and allowed the tool to drop about 25 feet back into the pipe. The impact of landing broke the stop washer off of the shaft allowing the lower portion of the tool to fall free. Everything from the male hex down was lost.

Advanced Piston Corer (APC)

The latest version of the Advanced Piston Corer, the APC-Mod II, was used for the first time on the Leg. It was deployed at ten holes. Results of coring in the upper calcareous sediments were excellent throughout the cruise. Recovery rates approached 100% even using the method of advancing the bit by one one joint length between cores. The Mod II version was successful enough to obsolete both the Mod I version and the VLHPC. The Mod I parts were boxed and returned to TAMU at the end of the Leg.

The Mod II tool has improved piston rod connections which make the three rod sections capable of being interchanged with other like parts without disrupting the continuity of the Anti-spiral groove which runs down all three rods sections. These rod connections are capable of withstanding 100,000 pounds of overpull to extract a scoped barrel from sticky sediments. No damage to the rod connections was observed when overpulls approaching this level occurred. Improvements in the Mod II design were also made to improve handling and ease seal renewal. Each of these improvements proved to be worthwhile and effective. Piston core refusal was most commonly defined by partial strokes, accompanied by liner failures and marginal recovery. Use of the APC could have continued in these cases by increasing to three stainless shear pins (not used on this leg) but the convenience of being able to switch over to the XCB always made the decision simple. One APC sequence was terminated when overpull reached 80,000 lbs.

Two trouble areas nagged the APC deployments although did not impact core quality or amount of recovery - shear pin stubs getting into the gap between the Outer shear pin sub and the Piston rod, and expansion pins in the rod connections failing. Both of these problems occurred frequently enough to be a nuisance and caused some rig floor delays but neither resulted in serious loss of time or equipment. Both problems will be addressed to improve new components ordered in the future.
As in the past, the O-rings in the Liner Seal subs were occasionally found in the cores when using the APC but it was a very minor percentage of the time compared to the brief piston corer usage during sea trials where O-rings in the piston cores abounded. Nothing different was done to retain the O-rings in place but better results none-the-less resulted. Only a few liner failure problems were encountered - on the whole less than is normal. Partial strokes of the APC were often accompanied by liner collapse or crumpling at the top but the stiff formation causing the partial stroke may have been responsible as much as the incomplete stroke itself. A better liner seal system is

called for and will be investigated.

Hydraulic Bit Release (HBR)

The original intent was to test the HBR as much as possible during sea trials (up to four releases were anticipated) in order to determine if the tool was the best means of achieving open ended pipe for logging. The current, Mod IV ,version had only been deployed once during DSDP in its present form using a Hold Down Spring. Although it released easily on that occasion the history of the HBR has been such that confidence would require much more successful testing. Another HBR was successfully released on the Shakedown.

During Leg 101 HBR assemblies were lost at Holes 626B and 626D. The first was in the BHA when the string was inadvertently backed off 19 joints above the BHA. The second was lost when the pipe became hopelessly stuck and was severed.

Deck testing was performed on all HBR's assembled during the Leg. Each released normally although one was balky on the first attempt to deck release. That unit was taken apart and inspected but no problem could be found. Upon reassembly the C-ring was intentionally deleted in case that was the problem. The unit released at about 600 psi and the C-ring was not reinstalled. The C-ring is now somewhat redundant to the system with the advent of the hold down spring and is a pain to install and remove. The unit was deployed at hole 626D and caused no difficulties up to the point that the pipe became stuck after drilling and coring to a depth of 455m BSF, probably in a lot of sandy formation.

An HBR (with the C-ring deleted) was included in the BHA at hole 632B but was not released since the hole was terminated by oil shows at a subbottom depth of only 283m. The unit was deck tested after recovery and it released about 2" worth at 700 psi. Full release could not be demonstrated with the minimal flow possible with a Sprague pump. When the tool was dissassembled grit inside was very minor even though the hole had been quite sandy. The Liner was swelled enough at its top to make it reluctant to slide but nothing indicated that it would not have come off easily under the influence of 1000-2000 psi from the mud pumps.

The same HBR (the last full assembly on hand) was included in the BHA continuously for Holes 634A, 635A, 635B, and 636. It was brought back on board only between the last two holes and was not disassembled or cleaned. Hole 634A was cored to about 465m BSF where bad hole conditions and three instances of stuck pipe forced termination of coring. The hole was logged through the pipe with the new GST tool and the pipe was left suspended a few hundred feet above the sea floor during the two mile move to the next site, thus the HBR was not released. Hole 635B was cored to

113.7m when sand filled the bottom two drill collars and firmly stuck the core barrel. The pipe was tripped to remove the stuck barrel and the HBR was once again not released. The pipe and HBR was tripped back to drill Hole 636 which was terminated after 21m of hard going in limestone and apparently lots of sand. The HBR go-devil was dropped into the pipe immediately after pulling the last core barrel with the pipe very near the mudline. The core barrel had apparently swabbed a significant amount of sand into the pipe because the go-devil became clogged with and buried under sand by the time it seated in the HBR liner. No release could be achieved and the go-devil could not be engaged and recovered by the overshot. Upon disassembly the HBR mechanism was in good shape except that the liner had unscrewed 9/16" from the bearing spacer and become belled out about 0.080". The go-devil ports were plugged solidly with sand. The release sleeve did not appear to have been shifted. The grit in the working parts of the mechanism was minimal and would not have prevented release.

Rotary Core Barrel (RCB)

Nothing notable regarding the RCB occurred during the leg. Minor changes in the system during the hiatus all functioned as designed without problems - lengthening to accommodate the Long Top Sub, inclusion of a 2-lug Quick Release, a new Bolted Adjustable Latch Sleeve.

One RCB assembly was lost when it was stuck in the BHA and shot off with the stuck pipe at Hole 626D.

Storage Scabbards

The coring tool storage scabbards proved their value during the leg in providing a convenient storage and retrieval location for the coring tools without getting in the way of other operations. The scabbards are supposed to be water tight for holding either fresh water or an anti-corrosion solution. During the leg the bottom ends of the scabbards were altered to fix chronic leakage. The PVC caps were sealed shut, the lock bolts were removed and the bolt holes plugged.

Mag Multishot Orientation System

The piston corer orientation system was anticipated to be in great demand during the cruise but the co-chief scientists opted otherwise so no oriented coring was done. The Multishot instrument was deployed once (in its pressure case installed in the sinker bar assembly without non-mag extenders) to take a drift measurement. The non-mag drill collar was not picked up during the leg. A comprehensive report on the hows and whys of the system was written and filed with the L.O.'s, dynamic positioning folks and others so that the equipment can be readily put into service by whoever the first serious user turns out to be on some later leg.

Logging Winch

The new logging winch was used at three sites for running downhole logs and one hole where four separate severing charges were run to shoot off the pipe. The performance of the winch in every respect except minimum speed operation was up to all expectations. The new Schlumberger GST tool was said to require a logging speed of 200 ft/hr so the winch was tested (on deck) both uphole and down for minimum sustainable speed. Even with the drum 80% full the minimum sustainable speed in the deck tests turned out to be 200 ft/hr down hole and 100 ft/hr up hole. Below these speeds the drive system would occasionally stall although an attentive operator could easily bump the system gently to get it moving again. At the lowest speeds the Bignozzi hydraulic motor would tend to cog - that is, pulses corresponding to discharge of each individual piston stroke would be discernible in the motion of the drum itself. The cogging motion is very gentle, amounting to less than a few inches of cable movement, and should not be a factor in downhole resolution of cable speed with drag and vessel motion factored in. The limiting minimum speed is a matter of drum RPM, amount of cable on the drum, and load. The interaction of these variables is not exactly known but it was observed during GST tool deployment at Site 634 that low speed cogging was much more pronounced than during deck testing under no load. Experimentation at Site 634 to achieve minimum sustainable speed achieved a compromise of about 300 ft/hr where the drum would not stall and speed remained reasonably constant (varying between 280 and 315 ft/hr). The Schlumberger logging engineers were unable to say whether optimum (or acceptable) data from the GST tool would be achievable under those conditions of speed and cogging. If not the simple alternative would be to exchange the 4:1 gearbox for a 7:1 ratio box but this would seriously impact high speed capabilities. The GST tool is the only Schlumberger standard tool requiring the slow logging speed and it is not clear how often the tool will be part of normal logging operations in the foreseeable future. (The multichannel sonic tool or downhole televiewer may require similar low speeds.) The next slowest Schlumberger tool runs at 900 ft/hr while logging.

Other notes: the operator's chair was raised so that even short operators could sit down and still be able to see the cable as it spooled. A lot of hydraulic leaks were tended to by the ships rig mechanics; the reason why so many fittings were quite loose was never determined.

Core Barrel Handling Clamps

A new modified design for the old, reliable handling clamps was introduced on the Leg. The reason for the change was to reduce the cost of the old design. Three latch bolts OP3622 were broken during use of the clamps. Two failed while tightening the nut and the third failed when it was pulled by a tugger into the elevators accidentally while lifting an XCB barrel out of the pipe. The barrel fell back into the pipe luckily so that personnel injury was avoided. All of the broken bolts failed where the internal thread (which is much too deep) and the external thread reduce the usable cross-section to less than 0.14 sq.inches with significant stress concentration. Redesigned bolts with this weak link eliminated were requested for Miami to replace all old bolts on board since the latter are considered a safety hazard.

Sinker Bar Assemblies

Several changes were made to the sinker bar assemblies used in the past. A 2-lug Quick Release was included for ease of changing over to the non-mag sinker bars and pressure case required for Multishot orientation. A regular RCB swivel was included in lieu of the slimline sinker bar swivel used in the past. Each of these improvements worked out as hoped. The main problem with sinker bars was associated with the erratic behavior of the new coring winches. On two or three occasions the sinker bars were inadvertently pulled into the oil saver and resulted in damage to several components including the Spang jars. On one occasion the sinker bar assembly was pulled into the crown sheave while removing it from the traveling block. The sandline parted and the sinker bar assembly ricocheted out of the derrick and crashed into the awning structure over the core walk then rebounded into the crane boom.

Logging Operations

Three holes were logged during the course of Leg 101: 626B (Florida Straits), 627B (Little Bahama Bank), and 634A (Northeast Providence Channel). In general, holes were logged if they exceeded 400 meters in depth. This was true of the three mentioned above, but the option was available at one point to log Hole 633A, which penetrated to only 227 meters sub-bottom. The decision was made not to log this hole because of serious time constraints and not because of the sub 400 meter depth.

The logging run in Hole 626B started after the drill string was trapped in the lower part of the bore hole. Originally, an extensive set of logs had been planned for the hole, but the necessity of logging through the drill pipe limited the run to two tools, a standard gamma ray tool (GR) and a compensated neutron porosity tool (CNTG). Although the presence of the pipe affected the tool measurements, the run proceeded without any problems, covering the interval from 0 meters to 345 meters sub-bottom at a speed of 550 miles per hour (1800 ft/hr).

A set of open hole logs was finally run at Hole 627B, but this logging run was limited to the bottom 67 meters of the hole (469 meters to 536 meters sub-bottom) because of a cave-in just above the top of the logging interval. The three tools used on this run were a natural gamma ray tool (NGT), a litho-density tool (LDT), and a compensated neutron porosity tool (CNTG). These tools were trapped by the cave-in, and the wireline connection to them was apparently cut during the attempt to drill down far enough to free them. After the wireline was cut, various attempts were made to fish for the tools, but all of these were unsuccessful. Because both the LDT and the CNTG tools operate with radioactive sources, a cement plug had to be placed in the hole before tripping out. Aside from the problems due to the cave-in, however, the logging run went well. The winch was able to make the speed of 275 miles per hour (900 ft/hr), and the rig crew set up the tools quickly and efficiently.

The final set of logs was run in Hole 634A, but these were kept in the drill pipe because of poor hole conditions. A standard gamma ray tool (GR), a compensated neutron porosity tool (CNL), and a gamma spectrometry tool (GST) made up the logging run. As with the logging run in Hole 626B, the presence of the drill pipe affected the quality of the data, but in general the run went well, covering the interval from 0 meters to 409 meters sub-bottom with ten passes. During the course of GST logging, a stand of pipe 14-17 collars above the top of the bottom hole assembly radiated to a significantly higher level than all the other joints; likely causes for this are heavy rust accumulation or pitting. Most of the passes were made at a speed of approximately 100 miles per hour (330 ft/hr), and the winch was able to maintain this speed without cogging. When a pass was attempted at 70 meters per hour (200 ft/hr), however, the winch could not maintain a consistent speed, surging above and slowing below the required 70 meters/hour (200 ft/hr). This problem forced the Schlumberger engineer to change his logging program to a series of stations rather than a slow continuous pass.

Medical Summary

No major injuries/illnessess. Two serious eye problems, one resolved successfully, the other still under treatment and improving. One psychiatric and one orthopedic (X-ray) problem required shore facility referral.

The need for the requested X-ray equipment and medical library was obvious.

While the total ships population is only about 50% greater than the previous project, the number of cases seen was two to three times greater. This was due in part to a "flu-like" episode. The number of minor injuries treated may be less in the future.

This is a more complex environment with many new people.

An example of this is the effort under way to modify certain door handles which represent a threat for arm injuries. Especially to newly arrived visitors in the scientific party.

A back-up group of "pre-processed" physicians is essential to assure continuous quality coverage.

Satellite Communications Terminal:

Fortunately no problems were encountered in communications with the O.D.P. Headquarters. Most traffic was by telex, other modes also functioned well, such as voice data. Facsimile but were hardly used by the O.D.P. staff, this in contrast with the communications between SEDCO office and the SEDCO/BP 471 appeared.

During the last two weeks of the leg and intermittent problem in the BDE-unit which results in a drop in signal strength two or three times a day but can be overcome by quickly switching on and off this unit. TELESYSTEMS service will be ordered in Miami to correct this problem.

Terrestrial communications were hardly used in communication with the O.D.P. Headquarters but could play an important role in a case of a defective terminal.

OCEAN DRILLING PROGRAM
LEG 101

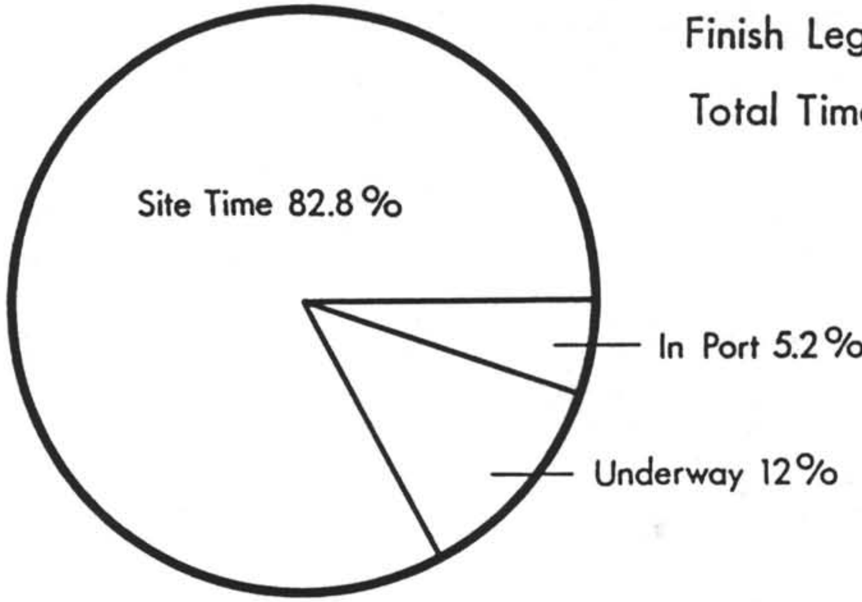
Total Days		43.8
Days in Port		2.2
Days Underway		5.3
Days on Site		36.3
	Coring Time	20.9
	Drilling Time	1.2
	Trip Time	5.9
	Downhole Measurements	2.2
	Mechanical Downtime	.3
	Condition Hole & Stuck Pipe	1.3
	Other	3.9
	Positioning Time	.6
TOTAL DISTANCE TRAVELED (NAUTICAL MILES)		
Average Speed		
Sites Investigated		11
Holes Drilled		19
Number of Cores Attempted		318
TOTAL Meters Cored		2977.8
TOTAL Meters Recovered		1429.7
Percent of Recovery		48%
TOTAL Meters Drilled		575.4
TOTAL Meters of Penetration		35.5
Maximum Penetration		535.0
Minimum Penetration		9.3
Maximum Water Depth		3601.0
Minimum Water Depth		561.0
Average Water Depth		1671.0

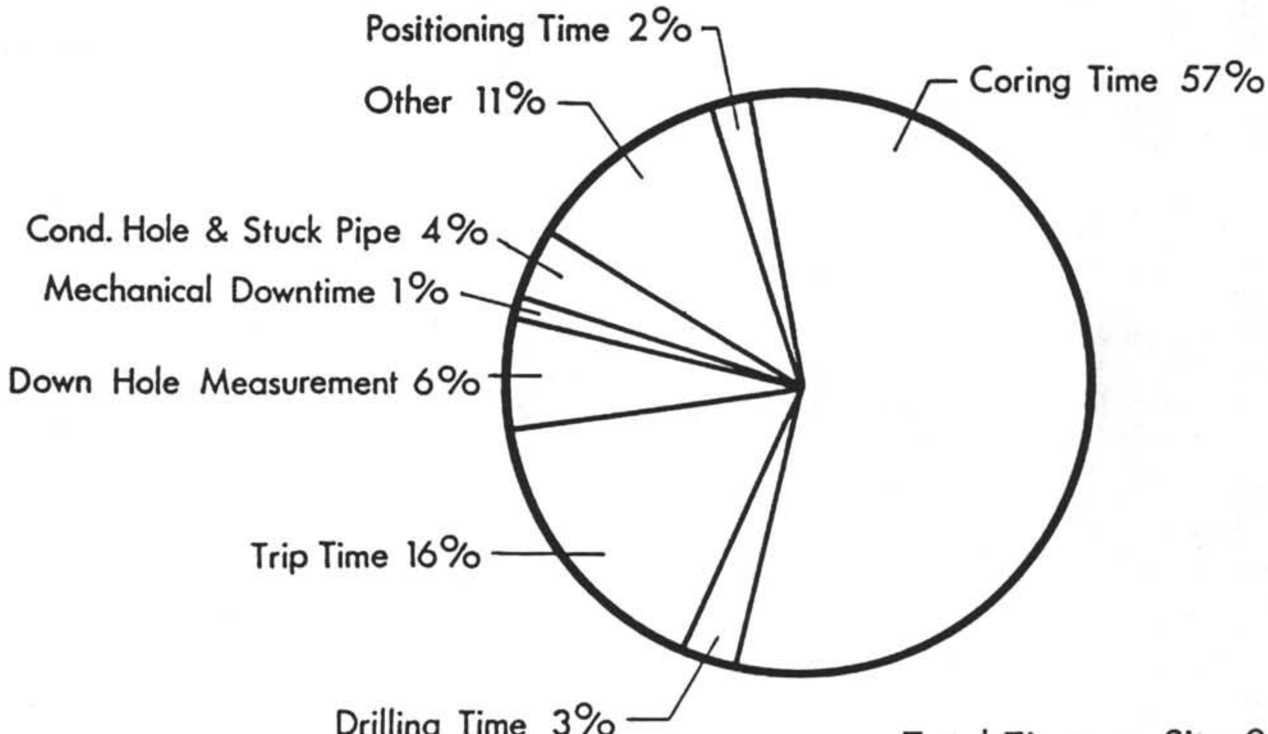
TIME DISTRIBUTION

Start Leg Jan. 31, 1985

Finish Leg Mar. 14, 1985

Total Time 43.8 days





Total Time on Site 36.3

Total Sites 11

Total Holes 19

OCEAN DRILLING PROGRAM
TIME DISTRIBUTION
LEG - 101

DATE	SITE NO.	CRUISE	TRIPS	DRILL	CORE	STUCK PIPE	DOWNHOLE MEASURE.	MECH. REPAIR	PORT TIME	POSITION TIME	OTHER	TOTAL TIME	REMARKS
29 Jan 85	626A								13.50			13.50	
30									24.00			24.00	
31		5.50							16.50	2.00		24.00	
1 Feb			8.00		8.25			.75		5.00	.50	22.50	
Feb 1-85	626B									1.50		1.50	
Feb 2			.75	12.75	8.00						2.50	24.00	Flush w/mud
Feb 3			2.00			.75					4.25	7.00	Fish out CB
Feb 3	626C		8.50		7.50						1.00	17.00	cir.
Feb 4					24.00							24.00	
Feb 5			6.00									6.00	
Feb 5	626D		6.00	9.00	3.00							18.00	
Feb 6					24.00							24.00	
Feb 7					22.50						1.50	24.00	Bit plugged
Feb 8						21.50	2.50					24.00	
Feb 9			3.50			4.75						8.25	
Feb 9		15.75										15.75	
Feb 10	627A	2.50	8.50		.50					3.50		15.00	

OCEAN DRILLING PROGRAM
TIME DISTRIBUTION
LEG - 101

DATE	SITE NO.	CRUISE	TRIPS	CORE	DOWNHOLE MEASURE.	MECH. REPAIR	OTHER	TOTAL TIME	REMARKS
Feb 10	627B			6.00			3.00	9.00	Rape Socket
11				22.50			1.50	24.00	
12				22.75			1.25	24.00	Cir.
13				22.25			1.75	24.00	Cir.
14				22.75			1.25	24.00	Cir.
15				18.50			5.50	24.00	Cond. Hole
16			1.50	1.25	19.25		2.00	24.00	Cir.
17		2.75			3.00		14.75	20.50	Fishing
Feb 17		3.50						3.50	
Feb 18	628		2.00	20.75			1.25	24.00	Dress CB
Feb 19	628		3.75	12.75				16.50	
Feb 19	629A	3.25	2.75	1.50				7.50	
20			.75	2.75		2.00		5.50	
Feb 20	630A	4.75	2.25	9.95			1.75	18.50	
21			1.00	9.25				10.25	
Feb 21	630B		1.75	7.25				9.00	
Feb 21	630C		3.25	.50				3.75	
Feb 21	631A	1.00						1.00	
22		24.00						24.00	
23		9.25	4.00	10.50		.25		24.00	
24			2.50	18.75			2.75	24.00	Inspection BHA
25							2.50	2.50	

OCEAN DRILLING PROGRAM
TIME DISTRIBUTION
LEG - 101

DATE	SITE NO.	CRUISE	TRIPS	DRILL	CORE	STUCK PIPE	DOWNHOLE MEASURE.	MECHNICAL REPAIR	POSITION TIME	OTHER	TOTAL TIME	REMARKS
Feb 25	632A	5.00	3.00		10.50				3.00		21.50	
26			5.50		13.00			.50			19.00	
Feb 26	632B		3.75					1.25			5.00	
27			7.00	4.25	12.50			.25			24.00	
28					14.50					9.50	24.00	Cir/CM
Mar 1			2.50								2.50	
Mar 1	633A	4.25	8.25		9.00						21.50	
2			5.00		14.00					.75	19.75	Plug hole w/mud
2	634A	4.25									4.25	Mudline
3		13.00	9.00							2.00	24.00	
4					19.50					4.50	24.00	Hunt mudline
5					22.00					2.00	24.00	Clean out hole
6					20.50	2.00				1.50	24.00	Retrieve Cente-
7			1.50		3.75	.50	11.00			7.25	24.00	Condition hole
8			1.25				17.50				18.75	
Mar 8	635A	5.25									5.25	
9		3.00	3.75		6.75				2.50		16.00	
Mar 9	635B	1.50			4.75			1.75			8.00	
10					24.00						24.00	
11			7.25		10.25					6.50	24.00	Stuck CB
12										8.25	8.25	Free stuck CB
Mar 12	636A		7.00		8.75						15.75	
13		11.50	7.50		1.75					3.25	24.00	Bit release
14		6.25									6.25	

OCEAN DRILLING PROGRAM
SITE SUMMARY
LEG 101

HOLE	LATITUDE	LONGITUDE	DEPTH METERS	NUMBER OF CORES	METERS CORED	METERS RECOVERED	PERCENT RECOVERED	METERS DRILLED	TOTAL PENETRATION	TIME ON HOLE	TIME ON SITE
626A	25 35.08N	79 32.13W	858.5	2	11.40	5.01	43.	0	11.40	24.50	
626B	25 34.87N	79 33.08W	859.5	5	47.50	13.96	29.3	138.40	185.90	32.50	
626C	25 34.87N	79 33.08W	858.	19	179.30	65.50	36.50		179.30	47.00	
626D	25 34.87N	79 33.08W	1300.	28	266.00	8.90	3	179.40	445.40	98.25	202.25
627A	27 34N	78 41W	104.4	1	8.80	9.40	106		8.80	12.50	12.50
627B	27 34N	78 41W	1036	60	535.00	344.20	64.2		535.00	171.25	171.25
628	27 31.83N	78 19.00W	974.	32	298.40	215.90	72		298.40	40.50	40.50
629	27 24.4N	78 19.00W	561	2	16.50	4.60	27		16.50	9.75	9.75
630	27 46.9N	78 20.39W	814.5	26	250.30	220.00	87		250.30	24.00	
630B	27 46.9N	78 20.39W	814.5	9	80.40	79.50	99.3		80.40	9.00	
630C	27 46.9N	78 20.39W	814	1	9.30	9.30	100		9.30	3.75	36.75
631A	23 35N	75 44.7	1102	25	244.30	160.00	65		244.30	41.00	41.00

HOLE	LATITUDE	LONGITUDE	WATER DEPTH METERS	NUMBER OF CORES	METERS CORED	METERS RECOVERED	PERCENT RECOVERED	METERS DRILLED	TOTAL PENETRATION	TIME ON HOLE	TIME ON SITE
632A	23 50.47N	75 26.09W	2006	16	141.00	85.50	59		141.00	35.50	
632B	23 50.47N	75 26.094W	2006	17	162.60	34.80	21.4	120.00	282.60	55.50	91.00
633A	23 41.0N	77 18W	1690	24	227.30	110.90	48		227.30	37.00	37.00
634A	25 23.02N	77 18W	3343	32	341.00	26.90	5.6	137.60	478.60	125.75	125.75
635A	25 25.09N	77 19.9W	3477	3	20.00	6.20	31		20.00	13.00	
635B	25 25.09N	77 19.9W	3483	14	117.70	30.80	26		117.00	62.75	75.75
636A	25°25.11N	77°18.35W	3581	2	21.00	.10	0		21.00	28.25	28.25
				318	2977.80	1429.74	48	575.40	3552.50	871.75	871.75

OCEAN DRILLING PROGRAM
BIT SUMMARY
LEG 101

HOLE	MFG	SIZE	TYPE	SERIAL NUMBER	METERS CORED	METERS DRILLED	TOTAL PENET.	CUMULATIVE METERS	HOURS THIS HOLE	TOTAL HOURS	CONDITION	REMARKS
626A	RBI	9 7/8	C3	AP634	12.70		12.7	12.7	1	1		RE-SPUDDED
626B	RBI	9 7/8	C3	AP634	47.50	138.4	184.9	197.6		19.75		LOST IN HOLE BACKED OFF
626C	RBMSD	11 7/16	S63	RR	189		189	189	47	47	T2B2OK	
626D	RBI	9 7/8	C3	AP636	266	179.4	445	445	54	54		LOST IN HOLE
627	HSMSDS	11 7/16		S 62	8.8		8.8	8.8				
627B	HSMSDS	11 7/16		S 62	535		535	543	65	65	T2B2OK	
628	HSMSDS	11 7/16	RR	S 62	298.4		298.4	841	11	76	UNK	LEFT IN DP GUIDESHOE
629	HSMSDS	11 7/16	RR	S 62	16.5		16.5	857			UNK	LEFT IN DP GUIDESHOE
630	HSMSDS	11 7/16	RR	S 62	250		250	1107	3	79	UNK	LEFT IN DP GUIDESHOE
630B	HSMSDS	11 7/16	RR	S 62	80.4		80.4	1187			UNK	LEFT IN DP GUIDESHOE
630C	HSMSDS	11 7/16	RR	S 62	9.3		9.3	1196		79		LEFT IN DP GUIDESHOE
631	HSMSDS	11 7/16	RR	S 62	244.3		244.3	1440	4	94	B7 T2 OK	
632A	HSMSDS	11 7/16	RR	S 63	141.0		141.0	141.0	1.5	1.5	B1 T2 OK	OLD DSDP
632B	RBI	9 7/8	C3	AP633	162	120	282	282	7.5	7.5	B1 T2 OK	

OCEAN DRILLING PROGRAM
BIT SUMMARY
LEG 101

HOLE	MFG	SIZE	TYPE	SERIAL NUMBER	METERS CORED	METERS DRILLED	TOTAL PENET.	CUMLATIVE METERS	HOURS THIS HOLE	TOTAL HOURS	CONDITION	REMARKS
633	HSMSDS	11 7/16	RR	S 63	227.		227	509	4.5	12	B1 T2 OK	
634	RBI	9 7/8	RR	AP633	479		479	761	13	20.5		RR FROM 632
635A	RBI	9 7/8	RR	AP633	120		20	781	1.5	22.00	B3 T7 OK	RR FROM 634
635B	RR	9 7/8	RR	AP633	117		117	898	9.4	31.4	B2 T2 G	THROAT MISSING FROM BIT
636	HSMSDS	9 7/8	RR	F94CK	12	9	21	21	3	3	B2 T2 G	

DATASONICS BEACON SUMMARY

S/N	FREQ	SITE	DATE	REMARKS
164	14.5	626A	1/31	High current caused tilt of beacon/very poor acoustics including total loss of signal. Ship lost location, beacon may have failed.
163	16.5	626B	2/1	High current area poor acoustics. Operated downstream of beacon position.
159	15.5	627	2/10	Very good operation, slack current area. Used beacon 2/10 to 2/17.
158	14.5	628	2/18	Used on taut wire. Good operation.
158	14.5	629	2/19	Used on taut wire. Good operation.
158	14.5	630	2/19	Used on taut wire. Good operation.
158	14.5	631	2/23	Used on taut wire. Good operation.
171	14.5	632	2/25	Deployed 2900 feet at 310 from desired location. Good operation used as a backup till 1 March.
161	14.5	633	3/1	IBS noisier, SBS less noisy than usual. We had a very strong signal with very few flags. We positioned on pipes with SBS enabled for the first time.
158	14.5	634	3/3	Good operation. 205DB used this beacon a total of twelve days.
174	15.5	635	3/9	Good operation 208DB - 12000 feet We had a period of poor operation (no signal) I believe this was due to thruster noise.
175	16.5	636	3/11	Good operation 208DB - 12000 feet