1. INTRODUCTION

Leg 2 of the Deep Sea Drilling Project commenced with the departure of the drilling vessel *Glomar Challenger* from Hoboken, New Jersey on October 1, 1968, and terminated in Dakar, Senegal, on November 24, 1968. During the seven-week period at sea, five sites (Figures 1 & 2) were drilled across the North Atlantic Ocean in an attempt to achieve the major scientific objectives outlined by the Atlantic Advisory Panel of JOIDES. These objectives were to sample the oldest available sediments in the deep sea, to test the hypothesis of continental drift and sea-floor spreading, and to recover a complete sequence of sediments to serve as a standard biostratigraphic reference section in the North Atlantic.

REGIONAL GEOLOGY

The track of the *Glomar Challenger* on Leg 2 traversed the entire North Atlantic, crossing the continental margins of eastern North America and western Africa, the deep North American Basin, the Bermuda Rise, the Sohm Abyssal Plain, and the Mid-Atlantic Ridge. The sediment of the western North Atlantic Ocean has been extensively surveyed using both refraction and reflection seismic techniques, but surveys in the eastern Atlantic are sparce. These surveys have revealed that the sediments are thickest near the continental margin (Drake *et al.,* 1959) and in a broad sense thin towards the axis of the Mid-Atlantic Ridge. Locally, however, it is clear that the sediment distribution is related to processes other than its proximity to the continental margin (Ewing, and Ewing, 1964; Ewing, Ewing, and Talwani, 1964; Ewing, Ludwig, and Ewing, 1964; Ewing, and Edgar, 1966). The patterns or trends in sediment distribution which have been observed and mapped (Ewing, Worzel, Ewing and Windisch, 1066; Saito *et al.,* 1966) proved to be of great value in designing a program to meet the primary objectives in the Atlantic Ocean and more specifically of Leg 2.

In the western North Atlantic, the sediments can be described in three fundamental provinces: the continental rise, the deep basins and the Mid-Atlantic Ridge. The sediments of the continental rise, described as a mixture of pelagic and terrigenous components (Heezen and Tharpe, 1959) are extremely thick (Drake *et al.,* 1959) and, consequently, no hole was planned in this area.

The stratigraphy of the deep basin that lies between the continental rise and the Mid-Atlantic Ridge in the western Atlantic has been extensively investigated by the Lamont-Doherty Geological Observatory (Ewing, Worzel, Ewing, and Windisch, 1966; Windisch *et al.,* 1968). Three major abyssal plains, the Sohm, Hatteras and Nares, almost surround the Bermuda Rise in the central part of the basin. These plains are formed by a thin veneer of sediment which contains turbidite deposits that overlie sediments acoustically similar to those on the Bermuda Rise. The turbidites, which show a high degree of stratification on the reflection profiler records, tend to pond in the deepest accessible parts of the basin and leave the shallower reaches—such as the Bermuda Rise—uncovered. Beneath the turbidite layers and on the oceanic rises, the sediment is generally free of fine stratification but is divided by strong, discrete reflectors or groups of reflectors that can be traced over large areas of the basin. The uppermost reflector, called Horizon A, is the most extensive and can be traced from the lower continental rise to the eastern flank of the Bermuda Rise. It was thought to extend to the flanks of the Mid-Atlantic Ridge. Horizon A refers only to the top of a thin layer composed of finely stratified sediments. An exposure of this horizon, and the associated layer, was discovered, cored and identified as an Upper Cretaceous turbidite (Saito *et al.,* 1966). Beneath Horizon A, another zone of reflectors, of which the top reflector is called Horizon β, has been mapped; but, it is not as strong a reflector as Horizon A nor as extensive. It has not been recognized east of the island of Bermuda. This horizon was also cored (Habib, 1969) and identified as a Lower Cretaceous carbonaceous-rich sediment. The third major reflector is the deepest one observed on the profiler records and is classified on the basis of topography and acoustical characteristics. Adjacent to the continent this reflector is relatively smooth and has acoustical properties that are suggestive of a lithified sediment. This reflector which extends eastward from the continental margin almost to the Bermuda Rise has been referred to as "smooth basement" or, more appropriately, Horizon B (Ewing, Worzel, Ewing and Windisch, 1966). Horizon B has not been sampled.

At the base of the soft ocean sediments lies a strong reflector characterized by a rough, undulating surface, beneath which no deeper reflectors can be identified. This reflector has been referred to as "basement" or "acoustical basement" and is well entrenched in the literature of marine seismic studies. In continental geology the term "basement" is commonly applied to a "complex, generally of igneous and metamorphic rocks, overlain uncomformably by sedimentary strata"

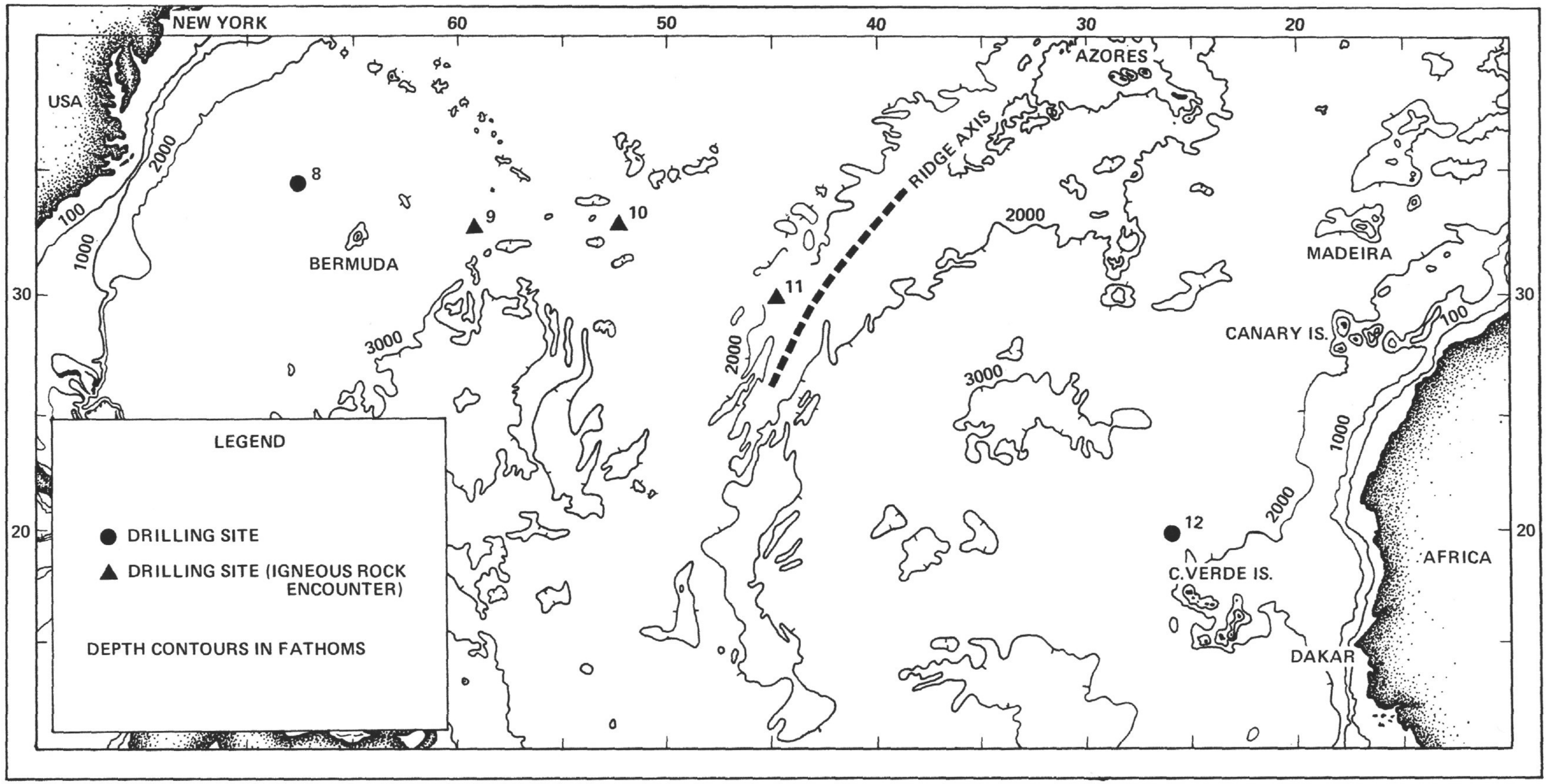

Figure 1. *Chart of the N. Atlantic Ocean showing the sites drilled on Leg 2.*

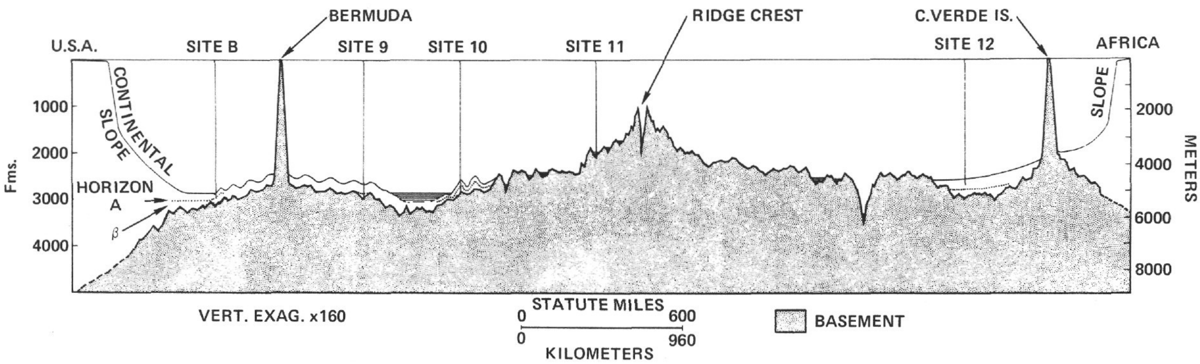

Figure 2. *Generated section along the track of Leg 2.*

(Weller, J., 1960), but concepts vary with geographic areas, local geologic conditions and economic objectives. The convenient marine seismic application of the term appropriately implies a similar relationship of soft oceanic sediments overlying a layer of rock. In this report the term "basement" is used in the marine acoustical context and refers to the deepest recorded acoustical reflector observed on seismic records in the area, characterized by an incoherent reverberant reflection and a rough surface topography. It is assumed that the basement surface approximates the bottom of the sedimentary column, although it is recognized that older sediments may be incorporated within basement associated sills and flows.

The general distribution and acoustical character of the sediment accumulations on the Mid-Atlantic Ridge was discussed by Ewing, M., J. Ewing and Talwani (1964). Other surveys have subsequently borne out their earlier findings: that the sediments in the North Atlantic are ponded between the high peaks of the basement topography. The areas between the ponds are almost or entirely barren of sediment. On the lower flanks of the ridge a thicker, almost continuous layer of sediment covers the basement topography. Reflectors within the otherwise acoustically transparent ponded sediments observed on the lower flank are absent on the upper flank of the ridge. (Within 50 to 75 kilometers of the ridge axis there is little sediment noted on the profiler records.)

Magnetic anomalies over the crestal part of the Mid-Atlantic Ridge, at least to about anomaly 5 or about 125 kilometers on either side of the crest, are parallel to the ridge axis and are symmetrical about the axis (Phillips, 1967). Beyond 125 kilometers from the ridge axis the magnetic interpretation is not clear. In the North Atlantic Basin the large amplitude magnetic anomalies are present; close to the continental margins the magnetic anomaly field is relatively flat (Hiertzler and Hayes, 1967).

THE PROPOSED SITES

To achieve the aforementioned primary drilling objectives in the Atlantic Ocean, the Atlantic Advisory Panel recommended sites in order to: (1) sample the oldest sediments, (2) test hypotheses that predict involvement of the Mid-Atlantic Ridge in the development of the basin, and (3) recover complete sedimentary sections for paleontologic and stratigraphic studies.

From examination of the sediment distribution, the sediment recovered from standard oceanographic piston coring, and the relationships of subbottom acoustical reflectors, it was apparent that the sites selected for the oldest sediments should be located close to continental margin–immediately seaward of the thick terrigenous accumulations. No sites were planned in the western basin for this purpose on Leg 2, but a site was proposed in the eastern Atlantic where old sediments were believed to lie (Site 12, Cape Verde).

In order to examine the concept of sea-floor spreading, where the magnetic anomalies are not easily correlated, it was suggested that an age-spatial relationship be established by paleontologically dating the sediment immediately overlying the acoustical basement at a known distance from the ridge axis. A decrease in the age of these sediments toward the ridge crest would support the concept of sea floor spreading. Three sites were proposed on the west flank of the ridge and one on the east flank for this purpose. Two of these were selected on the lower flank of the ridge where a strong reflector has been recorded in many of the sediment ponds or pockets that typify the sediment cover. The site on the upper flanks of the ridge is also located over a sediment pocket but the reflector present on the lower flanks is absent. On the east side of the ridge axis one site was selected to test the age symmetry across the ridge inherent in the concept of sea-floor spreading.

A site was chosen north of the Cape Verde Islands to link the faunal relationships during the Mesozoic and Tertiary between the Mediterranean and Caribbean Seas. Another site due west of the Cape Verde Islands had been suggested for paleomagnetic-biostratigraphic interest.

THE DRILLED SITES

Prior to departure of the *Glomar Challenger* from Hoboken it was decided that Leg 2 would drill Site 8 which was not drilled on Leg 1. Site 8 is situated on a small rise between the Sohm and Hatteras Abyssal Plains and offers an opportunity to reach old sediments near the continental margin without first drilling through a thick turbidite sequence.

Considerable time was lost on Leg 2 because of mechanical failures which required a return to Virginia for five days in dry-dock. For this reason, three of the sites proposed by the Atlantic Advisory Panel were not drilled: one site on the lower flank of the Mid-Atlantic Ridge, one on the eastern flank and one due west of the Cape Verde Islands.

COMMENTS ON THE CORES

The sediment was cored using a 30-foot (9.1 meter) core barrel lined with a plastic sleeve. The barrel free-falls down the center of the drill-string and is locked in place over a 2 1/2 inch hole in the center of the bit. The core barrel is mounted on roller bearings so that once it has made contact with the sediment the barrel will slide over the cut column of sediment without turning, while the bit rotates normally. During the cutting of the core, it is sometimes necessary to circulate or pump sea-water (drilling fluid) down the drill string to clear away obstructions in the hole and to facilitate drilling. These operations often disturb or mutilate the sediment as it goes into the core barrel. It can be very difficult to ascertain whether the structures seen in the cores are bona fide sedimentary features or artifacts resulting from the coring operation (see "breccia" in Site 8). Coring distrubances, can of course, render many of the measurements doubtful, and care must be taken to establish the integrity of the core prior to sampling or describing. In many cases, certain measurements were not conducted on cores where disturbance is obvious. Samples for paleomagnetic and interstitial water investigations were not collected where no visible disturbance is evident must be viewed with suspicion by some investigators, such as, those interested in penetrometer or sonic velocity measurements. It can be readily believed that the fabric of the sediment has been greatly disturbed during the recovery process.

Recovery of soft sediment was poor because of loss from the core barrel through the core catching device. Near the end of Leg 2, Site 12, a plastic sleeve adaption to the core catcher was devised which greatly improved core recovery in soft material and which has been successfully used on subsequent legs.

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