10. SITE 93

The Shipboard Scientific Party[1]

SITE DATA

Occupied: March 20, 1970.

Position: 22°37.25'N.
91°28.78'W.

Water Depth: 3090 meters.

Total Depth: 1.5 meters.

Holes Drilled: One.

Cores Taken: One.

BACKGROUND AND OBJECTIVES

A brief description of the Yucatan shelf has been presented by Logan et al. (1969) and is as follows:

> "The Yucatan shelf is the submerged part of a low limestone plateau which also includes the Peninsula de Yucatan. The plateau slopes gently from south to north and is bounded on the west, north, and east by precipitous continental slopes which plunge from the submerged plateau margin to the abyssal depths of the Gulf of Mexico and the Caribbean Sea. The plateau margin normally is at depths of 550-900 ft, but in places it is shallower; minimum depths of 240 ft are recorded on the western margin, southwest of the Triangulos reefs. Much of the northern part of the plateau has been the site of limestone deposition dating from Tertiary time. During the late Quaternary, sedimentary conditions on the Yucatan shelf have been broadly analogous to those of the Tertiary and early Pleistocene, i.e, carbonate sediments have been deposited on the older limestone in much of the 22,000-sq mi shelf area. The hinterland adjacent to the shelf is a region of karst topography devoid of surface drainage systems; thus, river-borne detrital materials are not found in the sediments on the northern shelf."

The origin of the Campeche escarpment has been attributed to several causes. Some suggest that the scarp represents a fault scarp; others suggest that its origin is a function of upbuilding and outbuilding likened, in some cases, to that of delta building. Still others suggest that the scarp represents the detrital accumulation seaward of a barrier or reef complex.

There is no direct evidence to support the theory that the scarp is the result of faulting. The idea that a major barrier reef separates the evaporite-carbonates of both the Florida and Yucatan banks from the Gulf of Mexico has long been held by many petroleum geologists operating in the gulf.

No direct evidence for such a reef complex bordering the edge of the Yucatan shelf was found until very recently. Bryant et al. (1969) reported the recovery of Early Albian shallow-water algal and pelletal limestone along the eastern edge of the Yucatan shelf at a depth of approximately 1500 fathoms. This led them to suggest that a Lower Cretaceous reef trend bordered the east, north, and west portions of the scarp. The extension of the Lower Cretaceous reef trend to the western sectors of the bank was inferred from arcer profiles.

Ewing and Ewing (1966) were the first to infer that a drowned barrier reef underlies the edge of the escarpment. Their evidence was also taken from seismic reflection profiles. Uchupi and Emery (1968) also suggested the existence of such a barrier. Although Bryant et al. (1969) found direct evidence for the existence of Albian age shallow-water limestone on the Campeche Scarp, the exact depth of the barrier was unknown, but seismic profiles of the eastern bank indicated that the barrier was located at a depth of about 1300 meters.

Site 85 was not able to penetrate to the deep Campeche Scarp face beneath the edge of the abyssal plain because of rubble of dolomite rocks which destroyed the bit and jammed the core barrel. Site 86 was drilled about half-way down the Campeche Scarp face. After leaving Site 86, a profiler record was obtained along the strike of the scarp face at a depth of about 1600 meters (Figure 1). This disclosed a deeply incised valley in the scarp near Site 85 (perhaps the avenue of transport of the rubble to the area of Site 85) with a small amount of sediment in the bottom (Figure 2). In Figure 2 the approximate age boundaries encountered in Site 86, drilled about 30 miles to the northeast at the 1600-meter curve, are shown. It can readily be seen that if the sediment in the bottom of the incised valley could be penetrated, one could expect to enter the section beneath the Campeche Scarp about 1200 meters below the top of the Cretaceous section. This valley thus might provide a "window" to determine the deeper structure and composition of Campeche Bank. It was, therefore, decided to attempt to drill Hole 93 in the bottom of the valley.

A short core of Pleistocene foram nanno ooze was recovered at Site 93 between the sea floor and a subbottom depth of 1.5 meters. *Glomar Challenger* was at the site on March 20.

NATURE OF SEDIMENTS

General Description

The single core recovered from Site 93 can be considered to consist of two parts: (a) the upper 30 cm of unconsolidated Holocene, tan clayey nannofossil-foraminiferal ooze and olive gray, slightly clayey, moderately burrowed,

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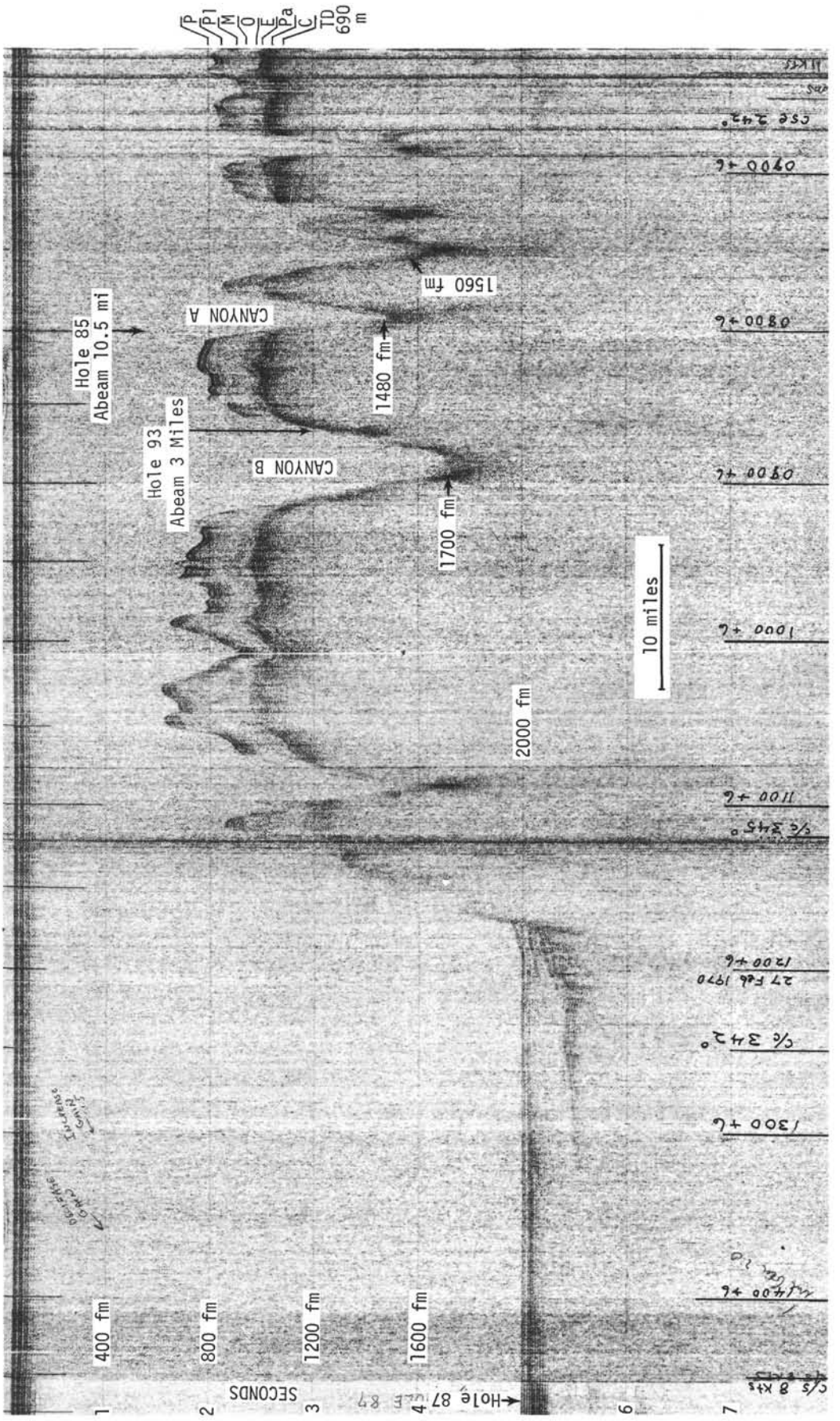

Figure 1. *Map showing track along the strike of the scarp face.*

foraminiferal, nannofossil ooze, overlying (b) approximately 1.5 meters of semi-consolidated, light greenish gray, strongly burrowed, foraminiferal, nannofossil ooze, ashy near the top. This latter lithology has been dated as Late Pleistocene in age. A zone near the base of the core contains displaced dolomite rock fragments (with moldic porosity) of probable Cretaceous age. These clasts are "floating" in a matrix identical to that above and below, although slightly lighter greenish gray in color. In turn, the Upper Pleistocene sediments also contain large amounts of reworked Miocene and Pliocene foraminifera and nannofossils.

In terms of physical measurements, the upper segment is unconsolidated, with a marked physical property disconformity between Holocene and upper Pleistocene sediments. Penetrometer measurements of the lower section show moderately firm or semi-consolidated readings. Bulk density is intermediate at approximately 1.55 gm/cc. Natural gamma data is approximately 1000 counts higher than values recorded for the stratigraphically equivalent section at Site 86, an apparent reflection of higher clay percentages at Site 93.

Sedimentological Interpretation

The presence of reworked sediment of various ages suggests considerable gravity slumping at Site 93. The essentially pelagic composition of sediments recovered at Site 93 suggests this slumping was intermittent and slow such that "overconsolidation" of these sediments was somehow facilitated.

Evidence as to the origin of the canyon at Site 93 does not appear forthcoming on the basis of this one short core. Within the framework of deposition reflected by the sediments recovered from the site, an interpretation of a bathymetric low or reentrant is all that appears to be required. If the canyon is an erosional feature, then the data in hand would suggest a history of erosion of any age but Late Pleistocene and Holocene. Such a history could conceivably be as old as Cretaceous. Increased clay percentages in sediments at Site 93, in contrast with slope sediments of equivalent age at Sites 86, 94, and 95, suggest that greater depth and proximity to the abyssal plain may be important considerations. As suggested by this writer in interpretations relating higher clay percentages in Pleistocene pelagites at Challenger Knoll (DSDP Site 2, Leg 1,), clay-rich turbidity associated with turbidity currents on the abyssal plain may have had considerable thicknesses (several hundred meters) such that dilute suspensions could reach bathymetrically high depositional sites.

BIOSTRATIGRAPHY

It is not likely that any of the material recovered that is older than Late Pleistocene, is in place. Probably the oldest in situ sediment recovered is latest Pleistocene to Early Holocene in age (10-93-1, CC). The slumping of Late Miocene and Pliocene sediments into the erosional feature ("canyon") during Late Pleistocene or Early Holocene suggests that the erosional feature is post-Pliocene, i.e., Pleistocene, in age.

Sample 1 (10-93-1, top):
Gephyrocapasa oceanica, G. kamptneri, Coccolithus pelagicus s.s., *Cyclococcolithus leptoporus leptoporus, Umbilicosphaera mirabilis,* and Cf. *Emiliania huxleyi.*
Age: Holocene: *Globorotalia tumida* Zone.
Environment: Bathyal.
Remarks: The sample also contains reworked Miocene and Pliocene floral elements including *Ceratolithus rugosus* and *Cyclococcolithus neogammation.*

Sample 2 (10-93-1-1, 139-142 cm):
Globorotalia truncatulinoides, G. menardii, G. tumida, G. unqulata, G. crassiformis, Globigerinoides ruber (pink), and *Sphaeroidinella dehiscens* (rare).
Age: Early Holocene: *Globorotalia tumida* Zone.
Environment: Bathyal.

Sample 3 (10-93-1-1, 144-145 cm):
Gephyrocapsa oceanica, G. kamptneri, Coccolithus pelagicus s.s., *Cyclococcolithus leptoporus leptoporus, Pseudoemiliania* sp., and Cf. *Emiliania huxleyi.*
Age: Latest Pleistocene to early Holocene: probably *Globorotalia tumida* Zone.
Environment: Bathyal.
Remarks: The sample contains sparse reworked Miocene and Pliocene calcareous nannofossils including *Ceratolithus rugosus* and *Cyclococcolithus neogammation.*

Sample 4 (10-93-1-2, 3-5 cm):
Globigerina nepenthes, Globigerinoides ruber (white), *G. obliqua, G. triloba, G. quadrilobata, Globorotalia miocenica,* and *Globoquadrina venezuelana.*
Age: Early to Middle Pliocene, (displaced).
Environment: Bathyal.

Sample 5 (10-93-1-2, 14.0 cm):
Discoaster quinqueramus, D. brouweri, D. exilis, D. variabilis, D. surculus, D. subsurculus, Reticulofenestra pseudoumbilica, and *Ceratolithus tricornulatus* (rare).
Age: Probable Early Pliocene, (displaced).
Environment: Bathyal.

Sample 6 (10-93-1-2,33-35 cm):
Globoquadrina altispira, G. venezuelana, G. sp. aff. *G. dehiscens, Globigerina nepenthes, Globorotalia* sp. cf. *G. miocenica, Globigerinoides obliqua,* and *Sphaeroidinellopsis* sp. cf. *S. seminulina.*
Age: Probable Early Pliocene, (displaced).
Environment: Bathyal.

Sample 7 (10-93-1-2, 72.0 cm):
Discoaster quinqueramus, D. exilis, D. surculus, D. brouweri, D. sp. cf. *D. asymmetricus, D. stellulus, D. pentaradiatus, D. subsurculus, D. variabilis, Reticulofenestra pseudoumbilica, Helicopontosphaera sellii, Pseudoemiliania lacunosa,* and *Sphenolithus abies.*
Age: Late Miocene or a mixture of Late Miocene and Pliocene, (displaced). **Environment:** Bathyal.

Sample 8 (10-93-1-2, 80-82 cm):
Sphaeroidinella subdehiscens, Globigerina sp. cf. *G. nepenthes,* and *Globorotalia* sp. cf. *G. miocenica.*

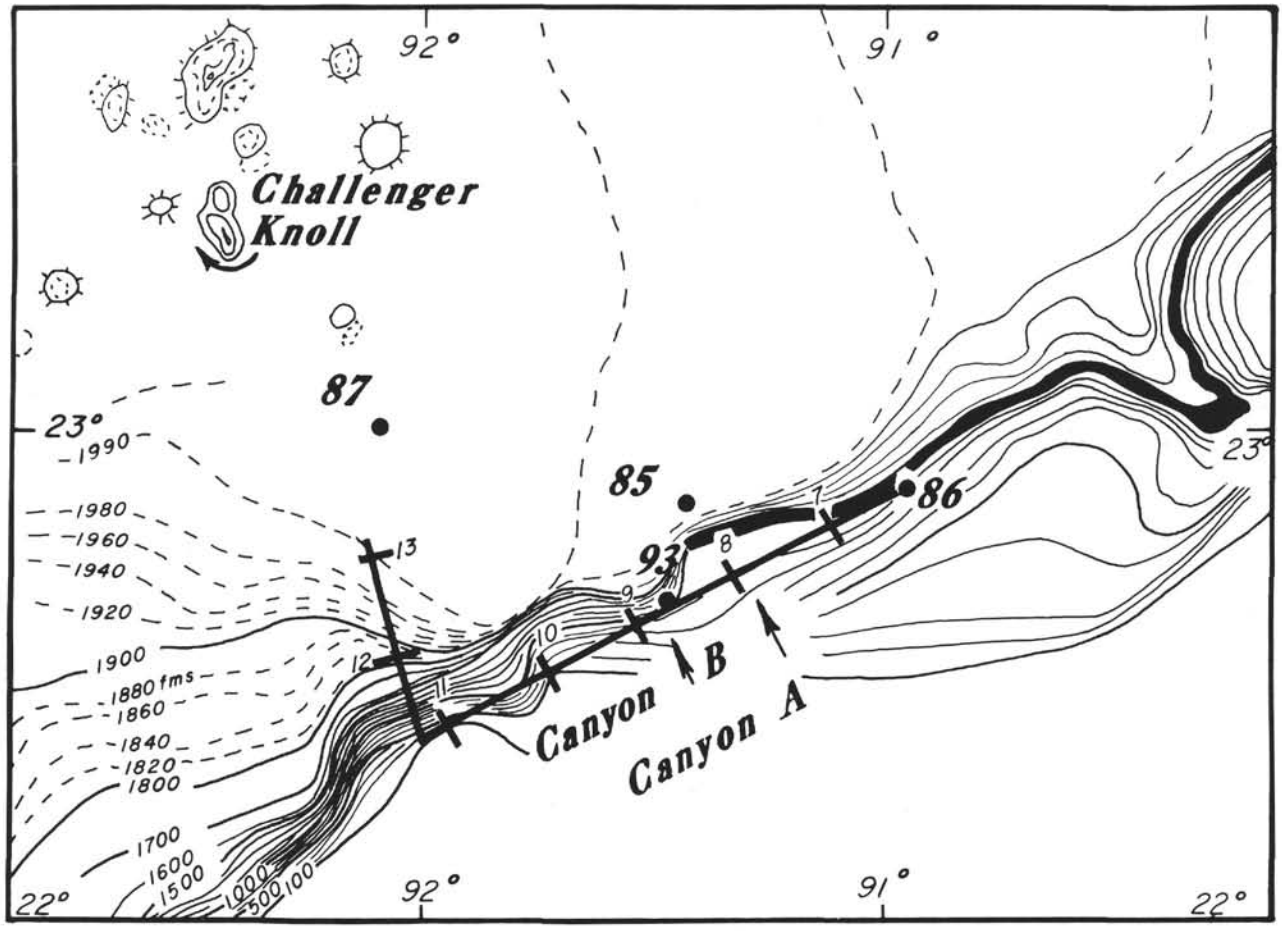

Figure 2. *Profile record showing deeply incised canyon in the Campeche Scarp and approximate age boundaries at Site 86. Note that Hole 85 is abeam of the track at the location where Canyon A is indicated and that Hole 93 was attempted in Canyon B.*

Age: probable Early Pliocene, (displaced).
Environment: Bathyal.

Sample 9 10-93-1-2, 142-144 cm):
Globigerinoides ruber (pink) and *Globorotalia truncatulinoides.*
Age: probable Late Pleistocene, *Globorotalia truncatulinoides* Zone.
Environment: Bathyal.
Remarks: The sample contains an assemblage of reworked Pliocene foraminifera including *Globoquadrina altispira, G. venezuelana, Globigerinoides ruber.* (white), *Globorotalia multicamerata, G. miocenica,* and *G. pseudomiocenica.*
Sample 10 (10-93-1, CC):
Globigerinoides ruber (pink) *Globorotalia tumida, G. truncatulinoides,* and *Gephyrocapsa oceanica.*
Age: Late Pleistocene to early Holocene: ? *Globorotalia truncatulinoides* Zone.
Environment: Bathyal.
Remarks: The assemblage, both faunal and floral, is predominantly of forms indicating reworking of sediments deposited during Late Miocene.

DISCUSSION AND INTERPRETATION

Site 93 had perhaps the greatest promise and resulted in the greatest disappointment. Equipment difficulties prevented the location of the proper site, and the sediments at the site chosen were so stiff near the surface that the bottom assembly could not be buried before fairly hard drilling was encountered, with the result that the bottom assembly broke off on two separate attempts. Only a surface core was recovered from near the foot of the westerly wall of the incised canyon.

All of the sediments recovered were laid down in a bathyal environment, and were Miocene, Pliocene, Pleistocene, and Holocene in age. Most, if not all, must have reached the site by slumping, since older sediments overlie younger within this single core. Further evidence for slumping would be the induration of the sediments which was similar to that found at a depth of 200 meters in nearby holes. Furthermore, their position is well below the level of similar ages traced by profiler from Site 86, about 25 miles to the northwest (see Figures 1 and 2). Careful examination of the profiler record shows two regions where layering is present, one near 1400 fathoms and the

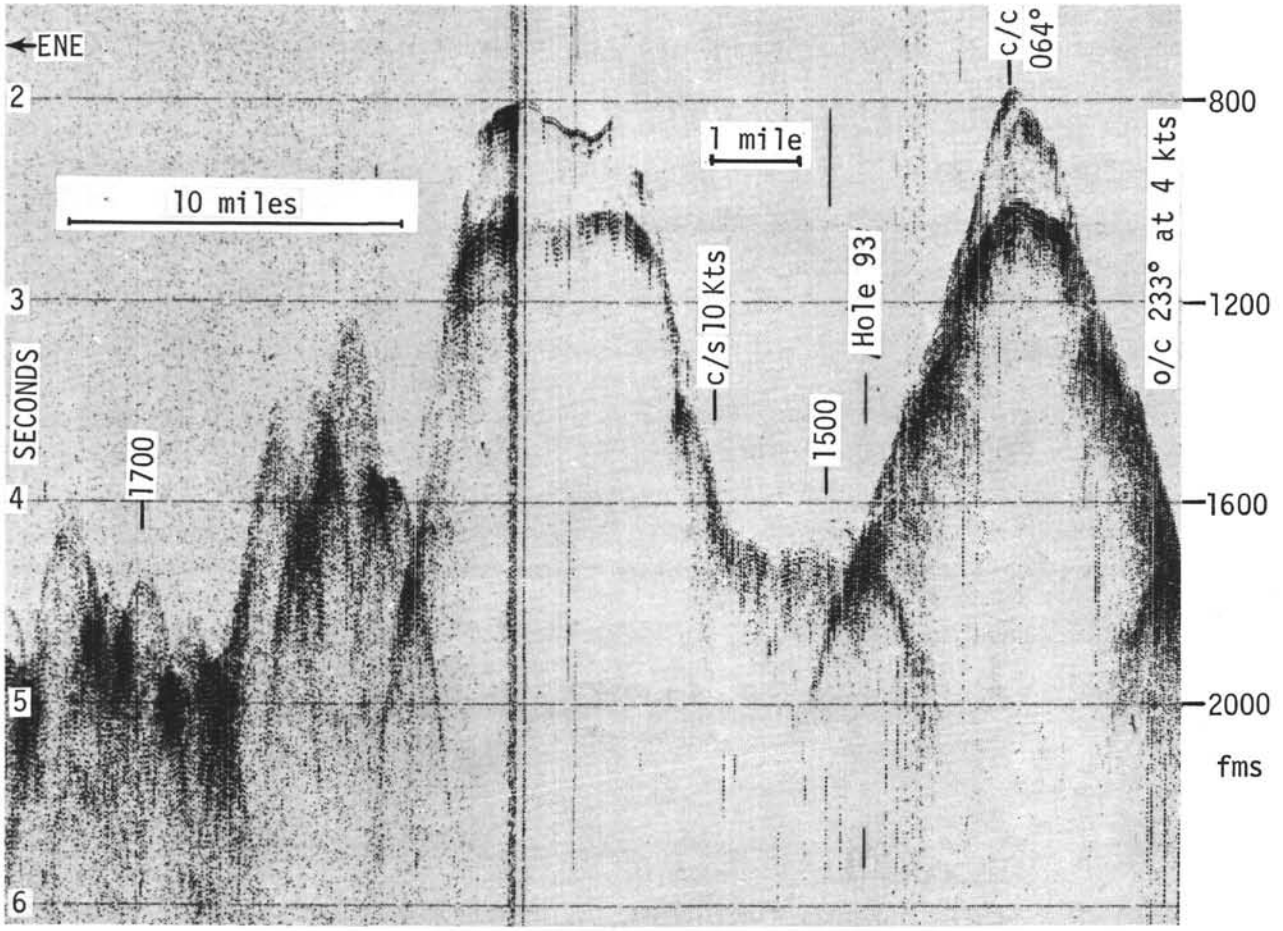

Figure 3. *Profile record, Site 93.*

second near 1600 fathoms. These appear to be similar to layering found at the 1000-fathom level at the top of the west wall. The hole was spudded in just above the deepest set of layers, as can be seen on the accompanying profiler record (Figure 3). This record could be interpreted to show two large blocks slumping down the west wall or as a couple of step faults. Resolution of the structure of the valley will require further work.

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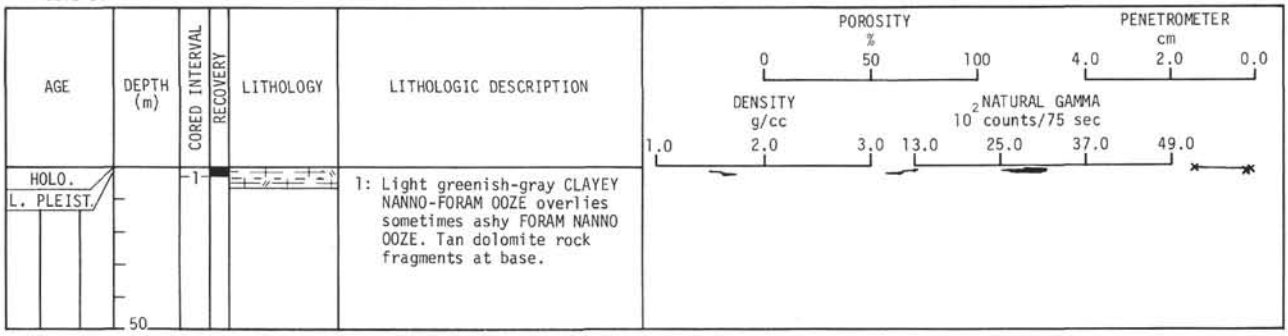
SITE 93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L. PLEIST.
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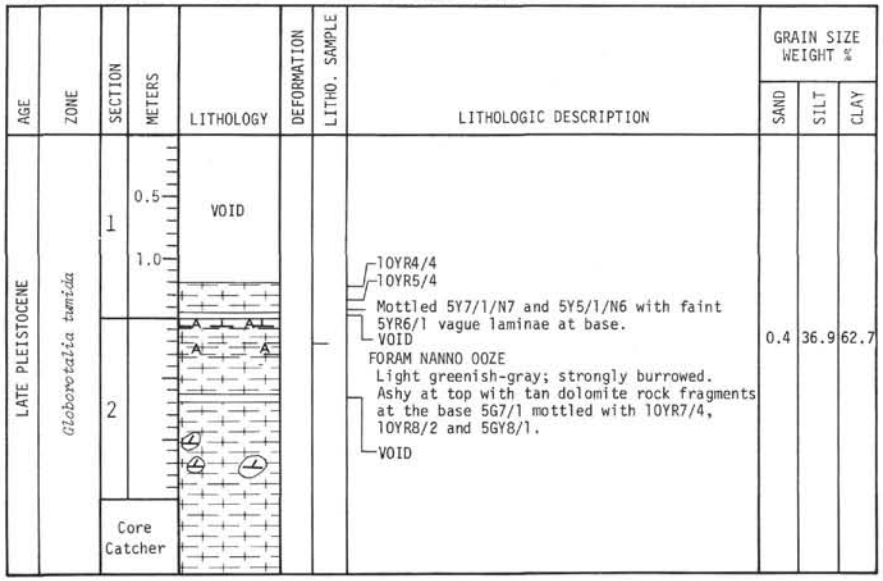
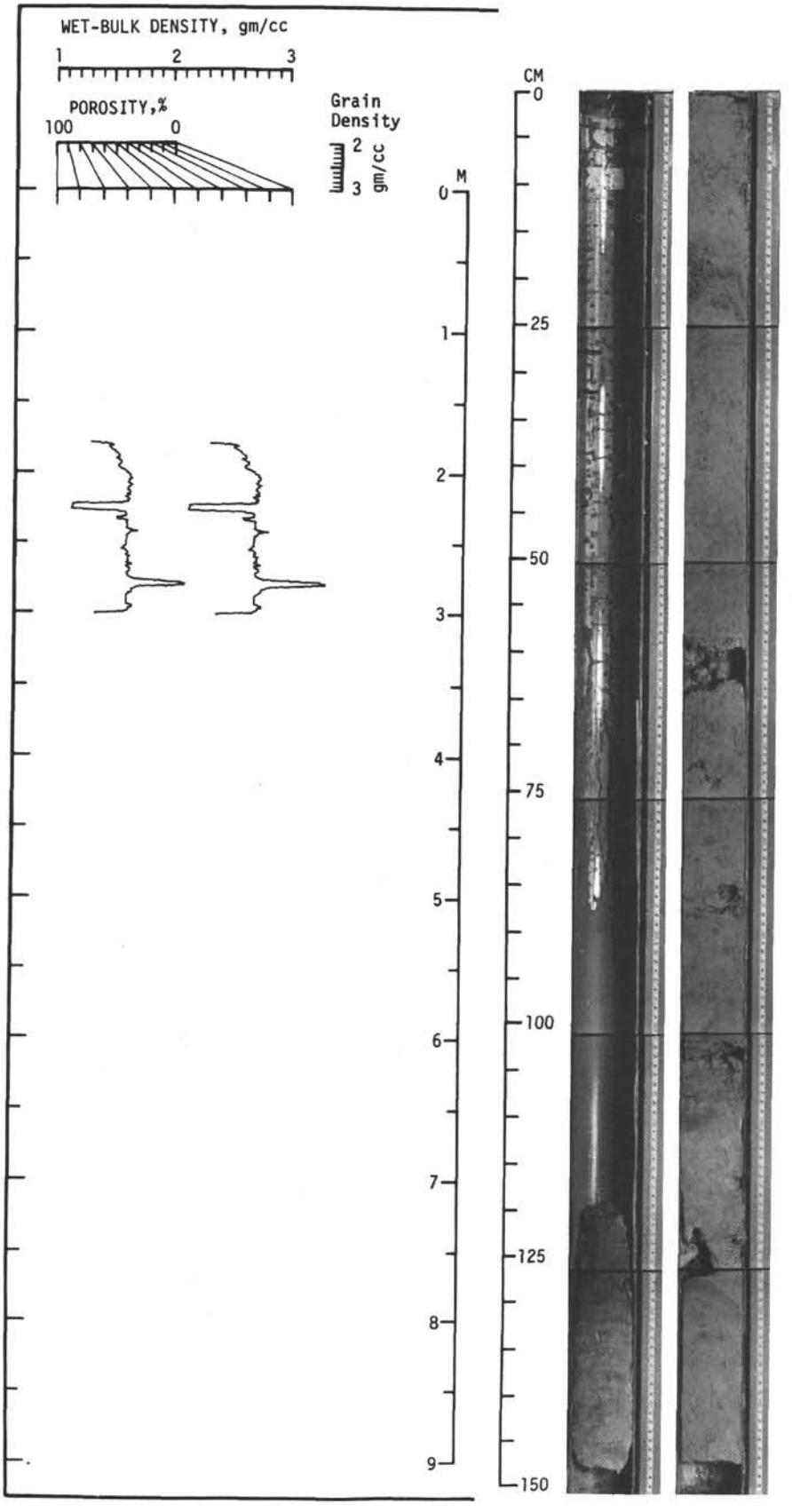
1: Light greenish-gray CLAYEY NANNO-FORAM OOZE overlies sometimes ashy FORAM NANNO OOZE. Tan dolomite rock fragments at base.

Site 93 Hole Core Cored Interval: 0-1.5 m

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