

INTRODUCTION¹

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The *Glomar Challenger* departed Orange, Texas, on July 20, 1968, completed acceptance trials on August 11, 1968, and concluded the work of Leg 1 in Hoboken, New Jersey, on September 23, 1968. During this campaign, eleven holes were drilled at seven different sites. As a result of the pioneering character of this work, many new records for drilling in deep water from a dynamically positioned vessel were established. These include: drilling in a water depth of 5354 meters (17,567 feet), use of a drill pipe length of 5650 meters (18,523 feet), and penetration beneath the sea floor of 770 meters (2528 feet). Scientific achievements of Leg 1 include the recovery of the oldest rocks (uppermost Jurassic) yet found in the deep ocean, discovery of petroleum and typical salt dome cap rock in the deep ocean, and demonstration of the important role of turbidites and radiolarian chert and hard limestone strata in deep-sea sedimentary deposits.

The planned drilling and coring operations of Leg 1 were severely curtailed by a decrease of two weeks in the time available, owing to a delay in acceptance of the vessel and an advance of the termination date in anticipation of labor trouble in the Port of New York. Despite this misfortune, three important areas were investigated—the deep basin of the Gulf of Mexico, the “Horizon A outcrop area” east of San Salvador Island, where the oldest sediments were expected, and the Bermuda Rise. The locations of the sites investigated during Leg 1 and a summary of the drilling results obtained are given in Figure 1 and Table 1.

SUMMARY OF DRILLING OPERATIONS AND RESULTS

Hole 1

Site: This is in the Gulf of Mexico on the Sigsbee Abyssal Plain² near the foot of the Sigsbee Scarp, which is a major break in topography between the continental slope and the abyssal plain.

Objectives: They were to study the stratigraphy and lithology of deeper sediments of Sigsbee Abyssal Plain near the Sigsbee Scarp. This hole was drilled mainly to obtain operational practice in deep drilling and coring.

Cores Taken From Hole 1

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	9789-9819	497-527	30
2	10,274-10,304	982-1012	15
3	10,785-10,815	1493-1523	7
4	10,850-10,880	1558-1588	0
5	10,880-10,910	1588-1618	8
6	11,560-11,574	2268-2282	14
7	11,574-11,604	2282-2312	30
8	11,760-11,790	2468-2498	30
9	11,790-11,820	2498-2528	30
			164

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	2983.7-2992.8	151.5-160.6	9.1
2	3131.5-3140.7	299.3-308.5	4.6
3	3287.3-3296.4	455.1-464.2	2.1
4	3307.1-3316.2	474.9-484.0	0.0
5	3316.2-3325.4	484.0-493.2	2.4
6	3523.5-3527.8	691.3-695.6	4.3
7	3527.8-3536.9	695.6-704.7	9.1
8	3584.5-3593.6	752.3-761.4	9.1
9	3593.6-3602.7	761.4-770.5	9.1
			49.8

Results: The whole section sampled was Pleistocene mudstone rich in detrital carbonates. Pelagic fossils are extremely scarce in this great flood of Pleistocene turbidites.

Three logs were made in Hole 1: an in-pipe gamma-ray/neutron log, an open hole gamma-ray and qualitative gamma-gamma (density) log, and a conventional open-hole resistivity log.

¹Lamont-Doherty Geological Observatory of Columbia University contribution No. 1362.

²The term Sigsbee Abyssal Plain will be used in this report to describe all of the deep floor of the Sigsbee Basin.

TABLE 1
Summary of Holes Drilled on Leg 1

Hole No.	Position Lat. Long.		Dates of Drilling	Water Depth Feet	Water Depth Meters	Penetration (Subbottom Feet)	Penetration (Subbottom Meters)	No. of Cores	Footage Cored	Meters Cored	Footage of Core Recovered	Meters of Core Recovered
1	25°51.5'N	92°11.0'W	August 12-16	9275	2827.0	2528	770.5	9	254	77.4	164.00	50.0
2	23°27.3'N	92°35.2'W	August 19-21	11,720	3572.3	472	143.9	6	117	35.7	43.50	13.2
3	23°01.0'N	92°01.4'W	August 21-23	12,294	3747.2	2059	627.6	11	320	97.5	154.00	46.9
4	24°28.68'N	73°47.52'W	August 29-31	17,452	5319.4	849	258.8	5	190	57.9	48.00	14.6
4A	24°28.68'N	73°47.52'W	September 1-2	17,452	5319.4	680	207.3	3	61	18.6	19.00	5.8
5	24°43.59'N	73°38.46'W	September 4-5	17,589	5361.1	263	80.2	3	90	27.4	21.00	6.4
5A	24°43.59'N	73°38.46'W	September 6-10	17,589	5361.1	914	278.6	7	129	39.3	5.75	1.7
6	30°50.39'N	67°38.86'W	September 12-14	16,815	5125.2	842	256.6	6	153	46.6	93.00	28.4
6A*	30°50.39'N	67°38.86'W	September 14-15	16,815	5125.2	78	23.8	1	30	9.1	28.00	8.5
7	30°08.04'N	68°17.80'W	September 16-17	17,013	5185.6	775	236.2	2	32	9.8	32.00	9.8
7A	30°08.04'N	68°17.80'W	September 18-19	17,013	5185.6	972	296.3	3	65	19.8	15.00	4.6

* Did not involve a trip to surface—merely a bottom surface core taken while coming out of Hole 6.

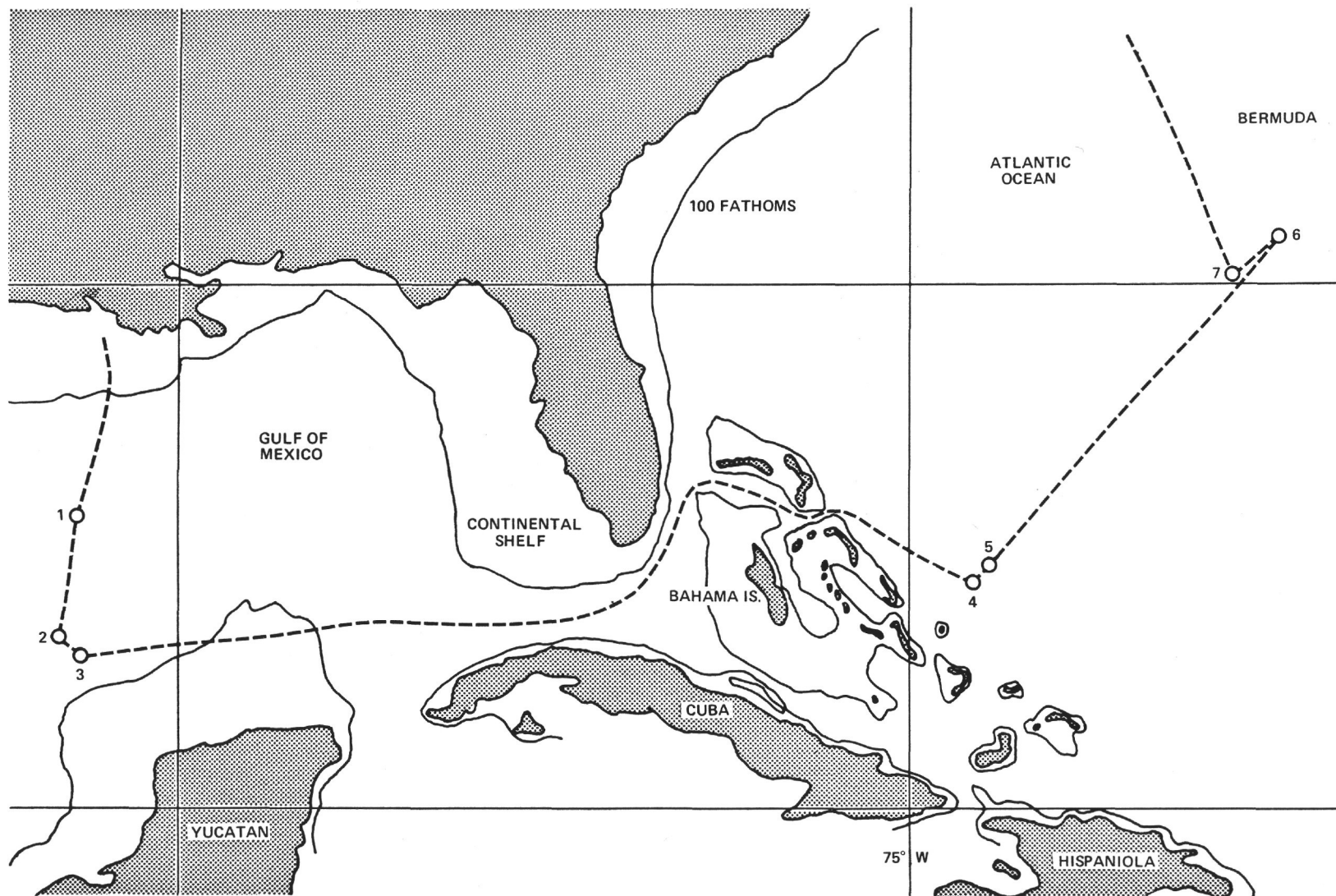


Figure 1. *Deep-Sea Drilling Project—Leg 1—12 August to 23 September 1968.*

Hole 2

Site: This hole is on one of the Sigsbee Knolls in the central part of the Gulf of Mexico. The Sigsbee Knolls, of which there are now more than 150 recorded, are known to extend along a southwestern trend to the Tabasco-Campeche Saline Basin in Mexico. This site is near the northeastern extremity of the belt.

This knoll, named by the shipboard scientific staff of the "Challenger Knoll," was chosen on the basis of prior surveys by Lamont-Doherty Geological Observatory because a sediment cover at about 450 to 500 feet was observed over the piercement material.

Objectives: The objectives of drilling here were to sample what was believed to be diapiric material under the knoll and to establish a pelagic Pleistocene stratigraphic sequence.

Cores Recovered From Hole 2

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	11,817-11,847	64-94	11.0
2	11,942-11,972	189-219	4.0
3	11,972-11,986	219-233	12.0
4	12,086-12,112	333-359	9.0
5	12,200-12,207	447-454	6.5
6	12,215-12,225	462-472	1.0
			43.5

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	3601.8-3611.0	19.5-28.7	3.4
2	3639.9-3649.1	57.6-66.8	1.2
3	3649.1-3653.3	66.8-71.0	3.7
4	3683.8-3691.7	101.5-109.4	2.7
5	3718.6-3720.7	136.3-138.4	2.0
6	3723.1-3726.2	140.8-143.9	0.3
			13.3

Results: Below 136 meters of Pleistocene and Pliocene pelagic sediments, a typical cap rock with gypsum, sulfur, limestone, oil, gas and traces of anhydrite was found. The presence of deep salt beds, probably Jurassic in age, is strongly suggested. This hole was abandoned and plugged, since there were rigid instructions to avoid any possibility of an uncontrolled flow of oil.

Hole 3

Site: This is on the Sigsbee Abyssal Plain near the Challenger Knoll.

Objectives: This site was drilled to obtain samples in the vicinity of the knoll of the sequence of normal

basin sediments—for comparison with the section found on the knoll—and for identification of the extensive seismic reflectors of this basin.

Cores Recovered From Hole 3

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	12,409-12,439	82-112	10
2	12,444-12,474	117-147	13
3	12,984-13,014	657-687	5
4	13,014-13,045	687-718	4
5	13,377-13,407	1050-1080	24
6	13,410-13,440	1083-1113	10
7	13,577-13,607	1250-1280	20
8	13,736-13,766	1409-1439	28
9	14,079-14,109	1752-1782	30
10	14,327-14,357	2000-2030	6
11	14,362-14,387	2035-2060	4
			154

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	3782.3-3791.4	25.0-34.1	3.1
2	3792.9-3802.1	35.7-44.8	4.0
3	3957.5-3966.7	200.3-209.4	1.5
4	3966.7-3976.1	209.4-218.9	1.2
5	4077.3-4086.5	320.0-329.2	7.3
6	4087.4-4096.5	330.1-339.2	3.1
7	4138.3-4147.4	381.0-390.1	6.1
8	4186.7-4195.9	429.5-438.6	8.5
9	4291.3-4300.4	534.0-543.2	9.1
10	4366.9-4376.0	609.6-618.7	1.8
11	4377.5-4385.2	620.3-627.9	1.2
			46.9

Results: Pleistocene sediments were brown to gray silty clays from the Mississippi Cone over a northeasterly-dipping calcareous section interbedded with calcareous turbidites. These were overly conformably, thick, carbonate Pliocene turbidites. The Miocene sediments to 2060 feet were mudstones rich in volcanics. The hole was abandoned on the basis of an order stating that 2000 feet penetration was the maximum permitted.

Hole 4

Site: Hole 4 is sited east of the Bahamas within the outcrop of the seismic reflecting Horizon A, at a place where Horizon β appears to be about 50 feet and Horizon B about 1200 to 1400 feet subbottom—supposedly, well within the reach of the *Glomar Challenger* drill.

Objectives: A major objective of the JOIDES program is to locate and recover the oldest sediments in the ocean basins. The primary objective of Site 4 was to obtain a sample of Horizon β and Horizon B.

Cores Recovered From Hole 4

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,485-17,515	0-30	30
2	17,827-17,857	342-372	7
3	17,924-17,954	439-469	5
4	18,111-18,141	626-656	5
-	18,238-18,268	753-783	No recovery
-	18,268-18,292	783-807	No recovery
5	18,304-18,334	819-849	<u>1</u>
			48

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5329.4-5338.6	0-9.1	9.1
2	5433.7-5442.8	104.2-113.4	2.1
3	5463.2-5472.4	133.8-143.0	1.5
4	5520.2-5529.4	190.8-200.0	1.5
-	5558.9-5568.1	229.5-238.7	-
-	5568.1-5575.4	238.7-246.0	-
5	5579.1-5588.2	249.6-258.8	<u>0.3</u>
			14.5

Results: Below about 600 feet penetration, the drill with increasing frequency encountered resistant and abrasive chert beds which wore out the bit, and caused operations at this hole to be terminated. The roller bit used here was completely destroyed by the chert.

Hole 4A

Site: This is the same as Hole 4.

Objectives: These were the same as for Hole 4.

Cores Recovered From Hole 4A

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,724-17,754	239-269	15
2	17,860-17,890	375-405	4
3	18,164-18,165	679-680	<u>Pieces of chert</u>
			19

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5402.3-5411.4	72.9-82.0	4.6
2	5443.7-5452.9	114.3-123.4	1.2
3	5536.4-5536.7	207.0-207.3	<u>-</u>
			5.8

Results: A drag bit was used in the hope that it might do better in the chert than the roller bit. Hole 4A passed through the same succession as Hole 4, and encountered the same hard abrasive cherts below 600 feet. At a depth of approximately 680 feet, the core barrel jammed and operations at this site were curtailed. After the pipe was pulled, it was found that the drag bit had been destroyed by the chert. These cores and those from Hole 5 may be discussed as a unit.

Hole 5

Site: Site 5, a short distance from Site 4, was chosen at the locality where Neocomian sediments, the oldest recovered in the deep ocean so far, had been recovered in piston core samples by Lamont-Doherty Geological Observatory. A smooth seismic reflector called Horizon B, which is normally deeply buried, was believed to be exposed at this locality; but, all of the beds are folded and distorted here, so the exact setting will not be known until a detailed site survey can be made. Objectives: These were to obtain samples of the oldest rocks and sediments yet recovered from the oceans.

Cores Recovered From Hole 5

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,600-17,630	0-30	14
2	17,702-17,732	102-132	4
3	17,833-17,858	233-263	<u>3</u>
			21

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5364.5-5373.6	0-9.1	4.3
2	5395.6-5404.7	31.1-40.2	1.2
3	5435.5-5443.1	71.0-80.2	<u>0.9</u>
			6.4

Results: A diamond bit was used here. The drill bit plugged at 260 feet of penetration, and drilling and coring were terminated.

Hole 5A

Site: This is the same as Hole 5.

Objectives: These were the same as for Hole 5.

**Cores Recovered From Hole 5A
Using Same Diamond Bit as for Hole 5**

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,880-17,900	280-300	0.25
2	17,921-17,950	321-323	2.00
3	18,076-18,106	476-506	0.50
4	18,206-18,207	606-607	1.00
5	18,357-18,362	757-762	1.00*
6	18,373-18,403	773-803	0.50
7	18,500-18,514	900-914	0.50
			<u>5.75</u>

*cobble

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5449.8-5455.9	85.3-91.4	0.08
2	5462.3-5471.2	97.8-98.5	0.61
3	5509.6-5518.7	145.1-154.2	0.15
4	5549.2-5549.5	184.7-185.0	0.30
5	5595.2-5596.7	230.7-232.3	0.30
6	5600.1-5609.2	235.6-244.8	0.15
7	5638.8-5643.1	274.3-278.6	0.15
			<u>1.74</u>

Results: Cores of coccolith ooze, cherty radiolarian mudstones, and gray and white chalk were recovered. Except for the topmost core, they are barren of foraminifera, but nanofossils indicate that they range in age from Cenomanian (upper cores) to Tithonian (Upper Jurassic, lowermost core). Layer B was not reached.

Once again the chert layers brought drilling to a halt. The plan had been to take an eighth core, and then to log the hole. However, while this was being attempted, the sand line parted and that plan was abandoned. When the diamond bit was recovered, it was found to be completely worn down, and with the edges of the center hole peened over.

At Sites 4 and 5, Tithonian sediments of open oceans facies were reached. The considerable thickness of underlying sediments shown by the seismic surveys suggests that this sedimentary regime had prevailed at least back to early Jurassic time. Turbidites, abundant Radiolaria, mudstones and cherts from late Jurassic to late Cretaceous are significant when compared to the radiolarian fauna of the same age found earlier in the Caribbean in Lamont-Doherty piston core samples, and then mentioned as suggesting a connection between the Caribbean and the Pacific. The cherts and hard limestones found in the Horizon A outcrop area were clear signals that deep-sea drilling might involve penetration of very resistant beds.

Hole 6

Site: This hole was drilled on the flank of the Bermuda Rise in an area where the profiler records indicated that Horizons A and β would be within reach of the drill. The site was far enough above the Hatteras Abyssal Plain that younger turbidites were not expected. Piston cores from the general area had indicated that good pelagic faunas might be obtained despite the depth of water.

Objectives: The objectives of drilling this hole were: to document the faunal changes across the Mesozoic-Cenozoic boundary, to determine the natures of Horizons A and β , and to examine Mesozoic-Cenozoic pelagic sedimentation.

**Cores Recovered From Hole 6
Using Christensen Drag Bit**

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	16,979-17,009	134-164	18
2	17,344-17,374	499-529	30
3	17,470-17,500	625-655	15
4	17,597-17,627	752-782	14
5	17,654-17,662	809-817	7
6	17,662-17,687	817-842	9
			<u>93</u>

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5175.2-5184.3	40.8-50.0	5.5
2	5286.5-5295.6	152.1-161.2	9.1
3	5324.9-5334.0	190.5-199.6	4.6
4	5363.6-5372.7	229.2-238.4	4.3
5	5380.9-5383.4	246.6-249.0	2.1
6	5383.4-5391.0	249.0-256.6	2.7
			<u>28.3</u>

Results: The drillers reported surprisingly hard drilling for the first 20 feet, after which the formations were soft. The first core was 134 to 164 feet of barren deep-sea clay. After penetration of the barren red clay over muds, clays and turbidites containing coccoliths, diatoms and Radiolaria totaling 842 feet were obtained. Progress was then stopped; the bit was destroyed by radiolarian cherts.

Hole 6A

Site: This is the same as Hole 6.

Objectives: After the abandonment of Hole 6, this hole was drilled, without a trip to the surface to test a very hard layer that had been reported by the drillers as forming the first 20 feet of the section at Hole 6.

Results: The drill pipe was pushed into the bottom without rotation to 50 feet of penetration without

encountering any resistant strata. Then a core was cut from 50 to 78 feet. It was found to consist of brown deep-sea clay. The nature of the topmost formation at Hole 6 remains an even greater mystery than before.

Hole 7

Site: This is about 50 miles from Site 6, on the flank of the Bermuda Rise in an area where it was hoped that Horizon β could be sampled, because the interval between Horizons A and β appeared to be less than normal.

Objectives: It was hoped that Horizon β could be reached and penetrated to recover samples of the underlying sediment.

Cores Recovered From Hole 7 Using a Diamond Bit

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,033-17,063	0-30	30
2	17,803-17,806	773-775	<u>2</u>
			32

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5191.7-5200.8	0-9.1	9.1
2	5426.4-5427.3	235.6-236.2	<u>0.6</u>
			9.7

Results: A brown deep-sea clay was encountered at surface as at Site 6. Below this was the expected mid-Eocene cherty turbidite section. The hole was terminated in pre-mid-Eocene, but otherwise undated, deep-sea clays. Drilling and coring operations were terminated because of damage to the core barrel when the vessel was allowed to roll in the trough of a moderate swell. A trip to the surface was necessary to retrieve the core barrel and modify another one to fit the same diamond bit. Core 7, Section 2, was a middle Eocene turbidite with chert, similar to that found at Site 6.

Hole 7A

Site: This is the same as Hole 7.

Objectives: These were the same as Hole 7—to try to penetrate the cherts and find the age of the sediment below.

Cores Recovered From Hole 7A Using Same Diamond Bit as for Hole 7

Core No.	Drill String (ft)	Penetration (ft)	Core Recovered (ft)
1	17,905-17,910	872-877	0
2	17,945-17,975	912-942	7
3	17,975-18,005	942-972	<u>8</u>
			15

Core No.	Drill String (meters)	Penetration (meters)	Core Recovered (meters)
1	5457.4-5459.0	265.8-267.3	0.0
2	5469.6-5478.8	278.0-287.1	2.1
3	5478.8-5487.9	287.1-296.3	<u>2.4</u>
			4.5

Results: The hole penetrated the mid-Eocene cherty turbidites, after much time spent at a slow drilling rate. At Core 7A, Section 1, the diamond center bit, badly chamfered by chert, was replaced. Very slow progress continued until much softer formations were found at 272 meters (902 feet) subbottom. Two cores between 912 and 972 feet each yielded 30 feet of barren deep-sea clays, considerably different in coloration and banding than any seen before. Ages from early Cenozoic to late Cretaceous have been suggested on the basis of extrapolation. The hole was abandoned at this point on orders from the Captain, who favored a safe margin of travel time to ensure arrival in port at a stated deadline.

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