1. INTRODUCTION

The *Glomar Challenger* departed from San Juan, Puerto Rico on 5 December 1970 on the fifteenth cruise and arrived in Cristobal, Panama on 2 February 1971 after drilling 9 sites (Figure 1). Sites were drilled in the Colombian and Venezuelan Basins, the Cariaco Basin (Trench), on the Aves Swell, Beata Ridge, and Nicaragua Rise. Columinar sections of each site are shown in Figure 2 and drilling data given in Table 1.

The overall scientific objectives outlined by the JOIDES Atlantic Advisory Panel were to determine the age and history of the Caribbean Sea and to establish a standard biostratigraphic section for the region.

Scientists of Leg 4 of the *Glomar Challenger* drilled three sites (see Table 2 and Figure 1) in the eastern Caribbean with similar objectives in mind. In the central Venezuelan Basin (Site 29) they drilled down to Middle Eocene cherts, believed to be the cause of a prominent subbottom reflector (Figure 3) called Horizon A" (Ewing, J. et al., 1968). These were the oldest sediments recovered during that cruise in the Caribbean Sea. Sediments of Miocene age were the oldest recovered at the other two sites (Aves Swell, Site 30; and Beata Ridge, Site 31). Left untouched and unknown were those sediments that lie beneath Horizon A″ and overlie another smooth strong reflector below which reflectors were rarely recorded. This smooth reflector is called Horizon B″ and, like Horizon A″ it extended throughout the Venezuelan Basin and could even be recognized west of the Beata Ridge to the lower slopes of the Nicaragua Rise.

The following are excerpts from Chapter 1 of Volume 4 of the Initial Reports (Bader and Gerard et al., 1970) giving a summary of the findings at each of the three sites:

SITE 29

Through the use of multiple holes, continuous coring was achieved to a hard Middle Eocene chert, but penetration of this layer proved impossible. Calcareous nannoplankton and planktonic foraminifera are abundant in the surficial strata to a depth of 100 feet (30.5 m) (Pleistocene-Pliocene). Between 100 feet (30.5 m) and 200 feet (61 m) the sediments are barren clays. Some calcareous nannoplankton are present between 200 feet (61 m) and 300 feet (91 m) but the planktonic foraminifera are either absent or largely dissolved. Good calcareous plankton assemblages occur in chalky materials at about 350 feet (107 m), dated as Lower Miocene. Immediately beneath this, barren zeolitic clays occur, but their exact thickness could not be determined. From 400 feet (122 m) to about 750 feet (229 m) the sediment consists of uniform pure radiolarian ooze of lower Upper Eocene and Middle Eocene age. Pumice and ash occur at several levels. Below 750 feet (229 m) cherts and cherty limestones impeded and finally terminated drilling. Drilling records would suggest that the cherty layers are separated by softer beds, probably radiolarian ooze. Logging records also bear this out. The record of plankton fossils at this locality is surprisingly incomplete. Most of the Miocene part of the section was apparently deposited below the level of carbonate compensation. A major hiatus appears to exist between the Lower Miocene and lower part of the Upper Eocene. The Upper Eocene-Middle Eocene radiolarian ooze is a valuable discovery; previously, no continuous sequence of this age had been found.

The age of Horizon "A" is the same as that of Horizon A in the North American Basin, as determined on previous legs. Both in-pipe and open hole logging were accomplished at this site, and correlations with lithology and physical properties were found.

SITE 30

The upper 1000 feet (305 m) of sediment are made up of soft clays rich in calcareous plankton fossils and ranging from Pleistocene–about 800 feet (244 m) thick–through Pliocene. Between 1000 feet (305 m) and 1400 feet (427 m), more indurated Miocene siltstones were extensively cored. The Middle Miocene strata between 1300 feet (396 m) and 1400 feet (427 m) are essentially globigerina ooze or globigerina sand, and the basal strata are rather hard. Although ash beds are found in the lower parts of the section, volcanic materials seem to have been particularly important sediment constituents in the Pleistocene, the Pleistocene sedimentation rate being about twenty times that of the Miocene and Pliocene. Nothing is known with certainty about the provenance of the volcanic materails, but the persistent westerly ocean currents from the nearby Lesser Antilles suggest that they, as well as the Aves Ridge itself, may be involved. Strong surface currents (probably extending to the bottom) severely hindered the ship's dynamic positioning system and eventually led to abandonment of this site before a planned second hole could be made.

SITE 31

Ten cores were taken in the upper 100 feet (350 m) of sediment. In contrast to Site 29, all of the strata were apparently deposited above the carbonate-compensation level except around 350 feet (107 m), where the tests of pelagic foraminifera have been largely dissolved (Lower Pliocene). The upper part of the drilled section [to 600 feet (183 m)], including Pleistocene, Pliocene, Upper and Middle Miocene beds, exhibits a normal rate of deposition for globigerina ooze. The strata between 680 feet (207 m) and about 1000 feet (305 m) are indurated chalk of Lower Miocene age, and must represent deposits laid down with a considerably higher rate of sedimentation. The drilling terminated at a depth of 1066 feet (325 m) due to a lodged center bit and broken wire line. The apparent absence of Horizon "A" indicated by profiler records could not be verified.

On Leg 15 the engineers were not only equipped with better drill bits, but they also devised a system that enabled them to replace a worn-out bit. With this improved technology it was hoped that the objectives lost to Leg 4 scientists could finally be met.

THE SITES

The origin and history of the Caribbean Sea were clearly the prime objectives of this cruise. To achieve them, Horizon B″ had to be sampled and hopefully cores could be taken from well below this level. The JOIDES Atlantic Advisory Panel recognized that several widely spaced "basement" holes should be included in the drilling program. One of these should be in the central Venezuelan Basin, not far from Site 29. The first site (146), 30 km to the north of Site 29, was selected in shallower water with the hope of obtaining a better biogenic carbonate assemblage from the Cenozoic sediments than achieved at the deeper Site 29. The shallower site may also optimize the chances of recovering datable sediments in contact with the crustal rocks. Another site was selected in northern part of

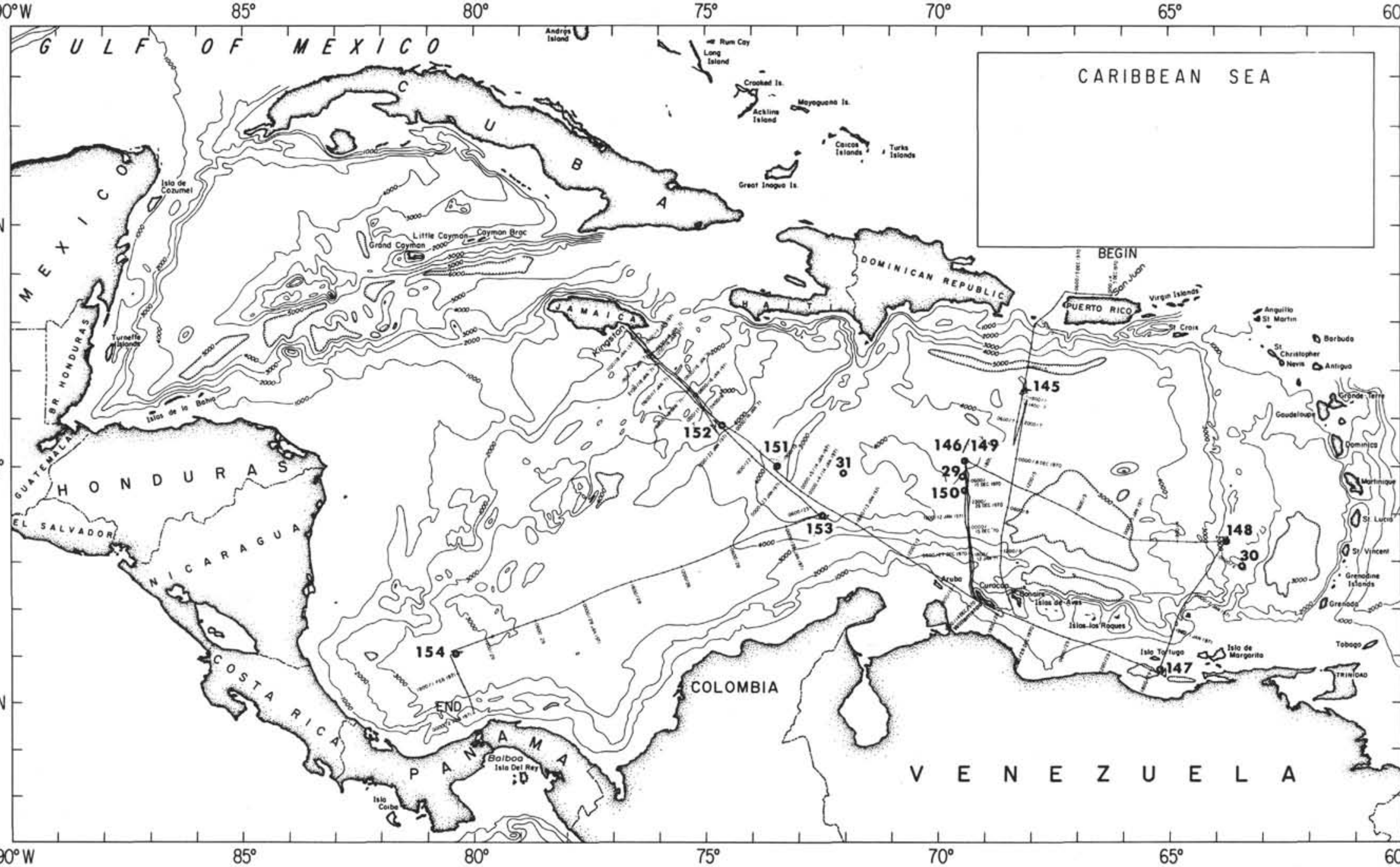

Figure 1. *Map of Caribbean and cruise track showing location of Leg 15 and Leg 4 sites.*

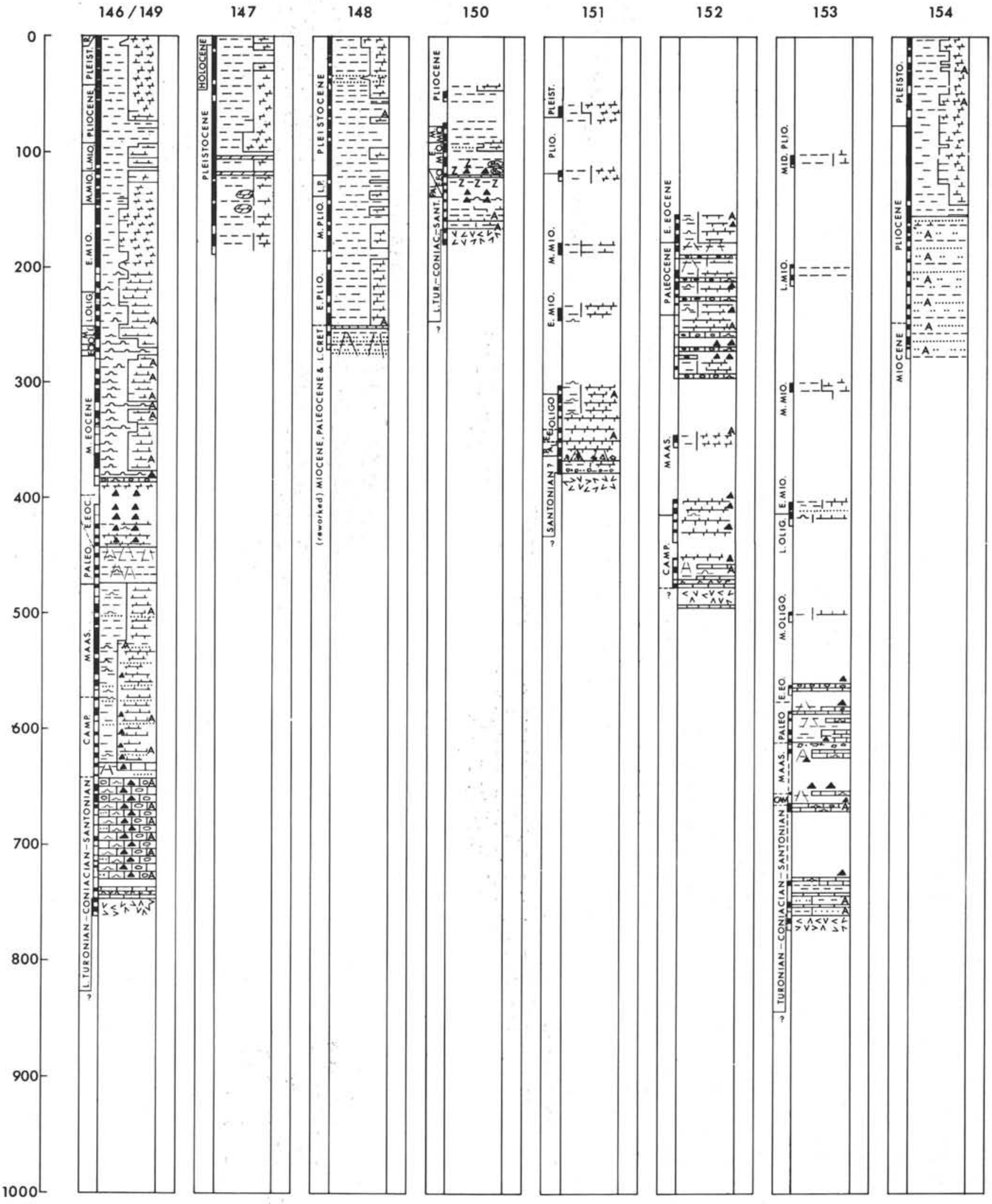

Figure 2. *Columnar sections of holes drilled on Leg 15.*

TABLE 1
Leg 15 Drilling Summary

Site	Hole	Latitude	Longitude	Water Depth (m)	Cores Taken	Meters Cored	Meters Recovered	Meters Drilled	Total Meters Penetrated	Per Cent Recovery
145	O	16°34.74'N	68°03.37'W	4358	0	0	0	0	0	–
146	O	15°06.99'N	69°22.67'W	3949	44	374	145.6	388	762	39
146	A	15°06.99'N	69°22.74'W	3949	1	9	4.6	87	96	51
147	O	10°42.48'N	65°10.48'W	892	18	162	119.2	0	162	74
147	A	10°42.68'N	65°10.45'W	892	2	13	6.5	0	13	50
147	B	10°42.68'N	65°10.45'W	892	12	115	81.0	10	125	70
147	C	10°42.68'N	65°43.45'W	892	8	73	32.1	125	198	40
148	O	13°25.12'N	63°43.25'W	1232	31	272	181.8	0	272	66
149	O	15°06.25'N	69°21.85'W	3972	43	390	239.9	0	390	57
150	O	14°30.69'N	69°21.35'W	4545	12	99	39.3	81	180	40
150	A	14°30.69'N	69°21.35'W	4545	2	18	1.0	110	128	6
151	O	15°01.02'N	73°24.58'W	2029	15	115	56.7	266	381	49
152	O	15°52.72'N	74°36.47'W	3899	24	211	59.0	266	477	28
153	O	13°58.33'N	72°26.08'W	3932	20	177	70.1	599	776	27
154	O	11°05.11'N	80°22.75'W	3338	14	132	66.0	146	278	50
154	A	11°05.07'N	80°22.82'W	3338	18	171	130.6	1	172	77
				Totals	264	2331	1233.4	2079	4410	53

TABLE 2
Leg 4 Caribbean Drilling Data

Site	Latitude	Longitude	Water Depth (m)	Total Meters Penetrated	Cores Taken	Meters Cored	Meters Recovered	Per Cent Recovery
29	14°47.11'N	69°19.36'W	4247	230	20	164.6	85.60	52.1
29A	14°47.11'N	69°19.36'W	4247	86	5	45.7	3.40	7.2
29B	14°47.11'N	69°19.36'W	4247	231	10	86.3	52.45	61.0
29C	14°47.11'N	69°19.36'W	4247	248	3	18.3	1.38	7.1
30	12°52.92'N	63°23.00'W	1218	430	16	132.9	61.70	44.6
31	14°56.60'N	72°01.63'W	3369	325	10	91.4	40.90	45.0

the Venezuelan Basin where the HMS *Vidal*, working in cooperation with the Lamont-Doherty Geological Observatory, steamed across a seamount which had a magnetic signature. It was hoped that igneous rock could be reached there with very little effort in case the other deeper sites failed. A third site was selected in the Aruba Gap where Humble Exploration & Production ran a seismic line (see Hopkins, this volume) from the continental margin into the Aruba Gap. The processed data revealed a layer of sedimentary (?) or volcanic (?) rock below Horizon B″ which is shaped like a wedge, thick toward the continent but thinning until it pinches out seaward.

A site was selected on each of the three main ridges; the Aves Swell, Beata Ridge, and Nicaragua Rise with the intention of examining the history of each (subsidence or emergence) and the nature of the upper crustal layers.

One site was selected in the extreme western part of the Colombian Basin where a small rise or fault block raised pelagic sediments above the thick terrigenous turbidites that dominate the surrounding sedimentary regime. The objective at this site was to examine, in proximity to Panama, the details of the final stages in the formation of the isthmus and to establish the identity of a strong seismic reflector.

The JOIDES Atlantic Advisory Panel, in cooperation with the JOIDES Panel on Inorganic Geochemistry and Panel on Organic Geochemistry, recommended the drilling of a hole in the Cariaco Basin (Trench) for the study of pore water and the changes in organic components with age and burial. The site was selected on a small saddle separating two deeps within the basin.

In addition to the Cariaco Basin site the geochemists wished to sample pore water from a typical basin environment and one in shallower water. A special team of geochemists would be assembled to do the sampling.

OPERATIONAL CONSIDERATIONS

The crew on Leg 4 made a very stout effort to penetrate the Eocene cherts, but without success. They tried several types of bits including diamond, but they were no match for the chert. Chert was also posing a problem in the Atlantic and Pacific oceans, so the DSDP engineers, in cooperation with Global Marine Inc. and Edo-Western Corp., prepared plans to assemble a system to change bits and reenter the same hole. The system was based on the Mohole design, which provided for a large cone to be planted on the ocean floor and a sonar device to protrude through the coring hole in the bit to search for the cone. The sonar head rotates through 360° and reflections are recorded on a radar-like scope on board the vessel. Movement of the pipe could be made by either moving the

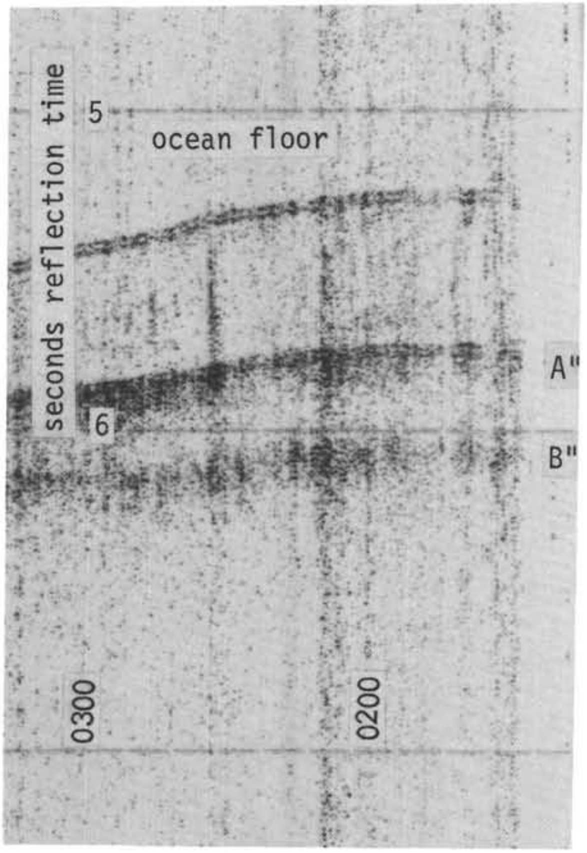

Figure 3. *Seismic profiler record showing Horizons A" and B"*.

ship or "jetting", that is, pumping water down the pipe and out through a nozzle in the side of the pipe near the bit.

At the same time a program was undertaken to acquire better bits that would crush (with knobs on roller-cones) rather than grind as with common drag bits.

The reentry system was successfully tested off New York in June 1970 and plans were made for it to be used in an attempt to reach Horizon B" in the Caribbean on Leg 15. At the same time plans called for our first test of a tungsten-carbide button-insert roller bit.

THE VOYAGE

The *Glomar Challenger* sailed from San Juan, Puerto Rico at 0008 5 December 1970 and steamed for Site 145, a small seamount in the northern Venezuelan Basin. The original HMS records and track were based on celestial navigation and a six hour survey was required to find the seamount. The site was never drilled because both bow tunnel thrusters failed before the pipe had reached the ocean floor. Fortunately the survey had been sufficiently detailed for Mr. A. Raff to map the magnetic anomaly (Raff, this volume). No site chapter was prepared for Site 145.

On completion of the thruster repairs the vessel sailed directly to Site 146. Two cores were taken in the soft Cenozoic sediments before the hard cherts and limestones were encountered. Coring was continuous from that point to the total depth of the hole. A complete analysis of the reentry system has been prepared under separate cover as Technical Report No. 2, Deep Sea Drilling Project, and may be purchased for $9.00 by ordering from the U.S. Department of Commerce, National Technical Information Service, 5259 Port Royal Road, Springfield, Virginia 22151.

The following is a brief summary of the reentry operations at Site 146: About 50 meters of 13 3/8 inch diameter casing were attached to a 60° cone, measuring 5 meters in diameter at the top, 4 meters high, and with three acoustic reflectors spaced equidistantly around its top (Figure 4). The cone and casing were in turn attached to the drill pipe with the core bit, and the entire assembly was lowered to the sea floor. The casing was pressed into the sediment leaving the cone at the sea floor. The drill pipe was then mechanically released from the cone and casing assembly. A normal drilling and coring operation was conducted through soft sediments to 406 meters below the sea floor, where Eocene limestone and chert were encountered. At 762 meters the pipe was withdrawn from the hole to replace the bit. A new core bit was installed on the drill pipe at the derrick floor and lowered to within 10 meters of the ocean floor. A transducer, which emits and receives a high frequency sound, was lowered on a conductor cable through the 5-inch diameter drill pipe to extend 6 inches below the core bit. The transducer scanned the ocean floor with 360° rotation, emitting a high frequency sonic beam which was reflected back by the cone. The cone was first located approximately 100 meters from the drill pipe. As the scanner sent out sound pulses and listened for the echoes, the engineers on the ships bridge directed the search on an illuminated screen like that used with a radar set. The captain moved the 11,000 ton vessel towards the cone; a maneuver that required delicate ship handling. When the *Glomar Challenger* was centered over the cone, the drill pipe was lowered and was thought to have reentered the old hole. However, after drilling 100 meters it was concluded that it had missed the reentry cone and a new hole was being drilled. This was confirmed by examination of a 9 meter core. The core bit and drill pipe were again positioned 20 feet above the sea floor and the sonic transducer lowered into place. The reentry cone was located approximately 30 meters from the drill string and the *Glomar Challenger* was again maneuvered directly above the cone. This time reentry was successfully accomplished.

The total time required for the reentry was 147.5 hours. The time required for the first reentry attempt, from sighting of the cone to lowering of the drill string, was 13 hours, while the same operation was accomplished in 2.5 hours on the valid reentry.

On completion of Site 146, the vessel returned to Curacao to return the reentry engineers and to pick up the geochemists (Dr. Wallace Broecker, Dr. Joris Geiskes, Mr. Ross Horoqitz, Mr. Richard DuBois). Paleontologists and geochemists agreed that the third geochemistry site should be to complete the Cenozoic section at Site 146. After Sites 147 and 148 were completed the vessel returned to within a few kilometers of Site 146 and drilled the Cenozoic section down to Horizon A" which was encountered at Site 146 at 406 meters, but at Site 149 it was about 390 meters.

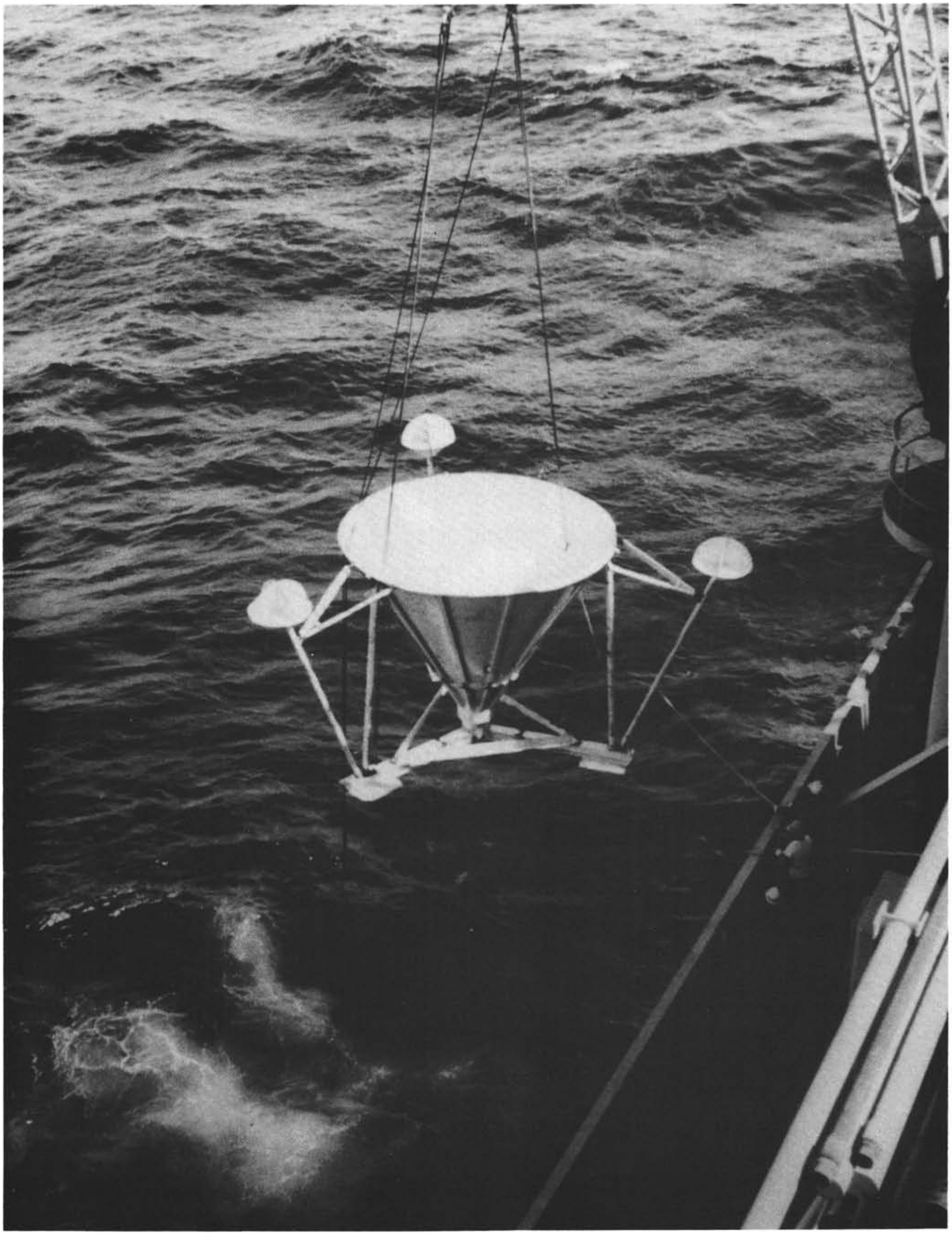

Figure 4. *Reentry cone being launched over the side of* Glomar Challenger *on Leg 15.*

By the time drilling at Site 149 was completed, there was still enough time before the scheduled port stop at Curacao to disembark the geochemists to drill another site. Site 150 was selected enroute to Curacao in the area of minimum sediment thickness. Horizons A″ and B″ appear to merge on the seismic record and it was thought that it would be complementary to the "typical" sedimentary section at Site 146/149. Time limitations did not permit continuous coring at this site.

After Site 149 was terminated the geochemists were returned to Curacao and Mr. Robert E. Boyce (physical properties), Mr. Warren Prell (Sedimentologist), and Mr. Perry Crampton (Technician) embarked.

On departure from Curacao the vessel bypassed the Aruba Gap because of time constraints and steamed toward the Beata Ridge where R/V *Vema* had completed a site survey. Site 157 was chosen on the crest of the ridge where the first (and only) reflector was well-defined. On some parts of the ridge crest the deepest reflector is not clear or sharply recorded. The hole was cored intermittently to an arbitrary depth known to be near the reflector. Plans to continuously core the upper section in a second hole at this site were aborted when the vessel had to make way for Kingston Jamaica for medical reasons. It was decided not to return to the site but to proceed to the next site on the Nicaragua rise.

R/V *Vema*, conducting surveys on some of the sites in the western Caribbean while *Glomar Challenger* was drilling in the eastern Caribbean, cored Maestrichtian carbonates from a fault escarpment on the lower flanks of the Nicaraguan rise, adjacent to the abyssal plains of the northern Colombian Basin. Site 152 was enroute to Kingston and it was decided to return to that location rather than drill the proposed site in shallower water. After establishing station, there was another personnel emergency that required a return trip to Kingston. The vessel returned to the same area and located the original beacon. The drill spudded in above the first subbottom reflector but coring did not begin until a few meters above the calculated depth of the reflectors. Coring was intermittent in the Late Cretaceous sediments because of slow penetration rates and poor recovery.

The youth and uniformity in age of the sediments overlying igneous rocks at each of the drilled sites (Late Cretaceous) had raised our curiosity about the nature of the material that lay beneath Horizon B″ in the Aruba Gap (according to the Humble Research and Production seismic line). This became a high priority objective so it was decided to return to Aruba Gap, even though there was not the capability to reenter and to try to penetrate Horizon B″ and core this older material. Drilling in the siliceous limestones at Site 153 was extremely slow, but dolerite of Horizon B″ was just sampled before the drill bit wore out. Horizon B″ was not penetrated but another Late Cretaceous date was determined for the oldest sediments.

Little time remained to drill Site 154 in the southwestern Colombian Basins, so the upper section was drilled until the approximate level of the single reflector to accomplish this first priority objective. When the nature of the reflector and underlying sediment was found to be transported volcanic sands, silts and clays, a second hole was drilled to core the upper section. This completed, the vessel was underway for Cristobal, Panama at 1515 hours, 1 February 1971. The vessel arrived at the dock in Cristobal 0700 2 February 1971, completing her fifteenth cruise.

Sediment Description

Nomenclature for the hemipelagic and pelagic sediments is the modified version of Olausson's (1960) sediment classification below.

$CaCO_3$/Clay

Percent $CaCO_3$	Term
0-10	clay
10-30	calcareous-rich clay
30-60	marl ooze
60-90	clay-rich chalk ooze
90-100	chalk ooze

However, Olausson's classification is used only for hemipelagic and pelagic sediments. Sediments that are composed of obviously reworked and bottom current transported fossils, or bottom current transported nonbiologic detritus, are size graded after the Wentworth (1922) scale and given a textural name after the Shepard (1954) sediment classification (Figure 5), the following is an example:

Sand/Silt

Percent Sand	Term
0-25	silt
25-50	sandy silt
50-75	silty sand
75-100	sand

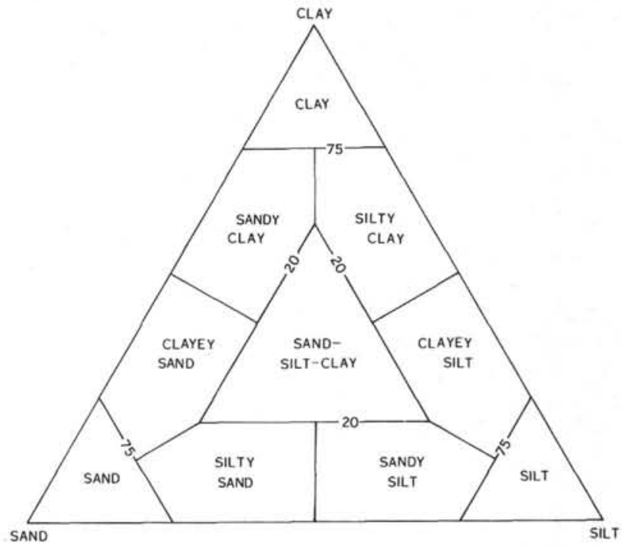

Figure 5. *Sediment classification after Shepard (1954) with the sand, silt and clay size fractions based on the Wentworth (1922) Grade Scale: Sand, silt, and clay size particles having respective diameters of 2000 to 62.5 microns, 62.5 to 3.91 microns and less than 3.91 microns. Shepard's (1954) sediment classification is a function of sand, silt and clay size percentages and not composition.*

The grain size data listed in Appendix III are routinely classified with Shapard's classification regardless of depositional origin. In the site chapters, Shepard's classification is applicable only to sediment of nonpelagic origin; thus, a nannoplankton sediment, classified as a silty clay in the grain size table, is designated either as a nannoplankton ooze or a nannoplankton silty clay depending on its depositional origin.

The various sediment root names are modified by adjectives based on the abundance and types of fossils or minerals present, such as annnoplankton marl ooze and foraminiferal nannoplankton marl ooze (may be shortened to foram nanno marl ooze). When more than one fossil or significant mineral is present, they are listed in order of increasing abundance.

The term "micritic" was used as an adjective whenever there was a recognizable amount of fine-grained carbonate of a nonskeletal origin.

Composition and percentages for terminology were estimated on board ship by microscopic observations of smear slides. These estimates were modified by the results of later laboratory analyses for $CaCO_3$ content, X-ray mineralogy, and grain size.

Degree of lithification was used to differentiate between the various biogenic sediments. The term "ooze" is applied to soft and plastic sediments easily deformed by finger of spatula. The terms marl and chalk without the ending "ooze" are used to describe slightly to well-indurated calcareous sediments. Compactness and susceptibility to mechanical deformation, such as friability and fracturing, are used as criteria for differentiation from the oozes. Radiolarian oozes that are semilithified are simply referred to as semilithified radiolarian ooze.

Highly compacted and hard sediments are termed "indurated". Indurated sediments required a band saw to cut them, but drilling often caused crumbling, fracturing, or abrasion. Where induration was present, sedimentary features like bedding and bioturbation were not deformed. In such sediments, the penetrometer test gives values approaching zero.

"Limestone" was used to describe the cemented carbonate rocks. The most obvious criteria used is the appearance of microspar and sparite infilling the chambers of the various microfossils. This is easily recognized on fractured surfaces as light-reflecting cleavage faces or by means of acetate peels. The indurated chalks disintegrate easily while soaking in water, tend to crumble, and have skeletal chambers usually empty or micrite infilled.

The term "clay" was used to describe both pelagic ("red") and terrigenous-derived fine-grained (clay-size) detritus.

Siliceous (silicified) limestone was differentiated from cherts by the higher carbonate content, by lower hardness (marked by a knife), by usual preservation of texture, by irregular versus conchoidal fracture, and by the similarity in color to the surrounding rocks. In thin sections, only parts of the sediment (usually infilling of microfossils) appear to be silicified.

The color description was based on comparison with GSA Color Charts.

Methods of Presentation

Lithology

Lithology is presented in three basic scales: (a) 0 to 400 or 0 to 800 meters per page, (b) 0 to 9 meters per page, and (c) 1000 meters per meter in a foldout in the back of the volume. The lithologic symbols are presented in Figure 6. Hole descriptions and core descriptions have a lithologic column in which vertical lines are used to separate symbols representing the major mineral or fossil components of the sediments. See Figure 7 for a complete display based on the classifications of Olausson (1960) and Shepard (1954). In this presentation, calcareous-rich clay is shown as a column of which two-thirds is "clay" symbol and one-third "chalk ooze or chalk" symbol, and marl ooze is shown as a column of which one-half is the "calcareous" symbol and one-half the "clay" symbol.

The lithologic symbols in the stratigraphic columns, where the entire hole is shown, are done with artistic license to show or "flag" the occurrence of sediments that were present, regardless of quantity. Therefore actual thicknesses of sediments may be exaggerated.

$CaCO_3$ and Grain Size Analyses

Results of $CaCO_3$ and grain size analyses are plotted within a single column in the core description with the $CaCO_3$ percentage represented by dark dots. The lines connecting the dots have no significance with respect to the data and may only suggest general trends. The grain size distribution is given as a composite histogram, with symbols representing (from left to right) sand, silt, and clay respectively. For detailed description of the analytical procedures, see Boyce (1972) and Bode (this volume) for grain size and Boyce and Bode (1972) and Bode (this volume) for $CaCO_3$. The numerical values of the $CaCO_3$ and grain size analyses are presented in Appendices II and III, respectively.

Deformation

Deformation is indicated by hatched areas and by an index number. The nature of the deformation is explained under this number in the lithologic description. Types of deformation and their index numbers are as follows:

Watery. Sediment with a high content of water, very liquid. Core usually not split.

Soupy. Mixture of pulverized sediment with undisturbed fragments in a watery mud.

Flow-in. Diapir-like structures or vertical to nearly vertical lamination. A result of plastic flowage and deformation of original horizontal bedding planes.

Fragmentation. Broken pieces of sediment, usually of indurated chalks and limestones due to coring disturbance.

Drilling Breccia. Abraded fragments of the sediment set in a fine-grained matrix, often of the same composition as the fragments. In case of a lithified sediment, a breccia or conglomerate is present.

Mixed Assemblages. Commonly, an otheriwse homogenous-appearing sediment yielded faunal and floral assemblages representing several zones. This disturbance is presumably a result of caving-in or washing-down and will be referred to as "mixed assemblages".

Flocculent Soup. Substantial disturbance was caused in few cores of Hole 149 due to the admixture of dyed fresh water in the drilling fluid. This fluid, used as a tracer by the geochemist, was subsequently trapped in or around the cored sediment. Due to the immense backlog in core description, many cores were stored unopened for about two days, by which time, the drilling fluid, aided by the ship's vibration, caused disaggregation of the sediment into a flocculent soup.

Physical Properties

Methods for measuring physical properties are described in Appendix I.

Natural gamma radiation is presented with the air background subtracted; therefore, zero is the air background count. The "†" symbol is located on the graph where the low gamma values are artifacts resulting from the end of the core being scanned with a reduced sample volume.

The Gamma Ray Attenuation Porosity Evaluator (GRAPE) wet bulk density and porosity data are presented in several forms. "G.C.D." indicates GRAPE Corrected Diameter data (unenclosed dots or dotted lines), which is data corrected for cores that had smaller diameters than the core liner (see Appendix I for detailed discussions).

Investigators should be aware that GRAPE data are measured before the core is opened; therefore, the degree of disturbance as indicated by the core photographs or by deformation symbols on the lithologic descriptions should be evaluated with the GRAPE records. They should also realize that, due to shifting within the core liner, hard rock fragments may have changed positions between the GRAPE measurement and the photographing of the cores.

Other symbols used in the hole and core plots are enclosed dots for:

1) discrete samples of wet-bulk density and porosity;
2) discrete sample determination of water content.

The penetrometer graphs have a designation of CP, which means complete penetration to the core liner.

Paleontology

The location of samples taken for paleontologic analysis are indicated on the core barrel summaries by the letters F, N and R for foraminiferal, nannofossil and radiolarian samples, respectively. Abundance, preservation and absences are indicated as shown in Table 3.

TABLE 3
Paleontologic Symbols

Paleontologic sample		
F	–	Foraminifera
N	–	Calcareous nannofossils
R	–	Radiolaria
Abundance		
A	–	Abundant
C	–	Common
F	–	Few
R	–	Rare
Preservation		
W	–	Well preserved
M	–	Moderately well preserved
P	–	Poorly preserved
Absences		
f		Foraminifera not present
n		Calcareous nannofossils not present
r		Radiolaria not present

Data Storage

All information contained in this volume is filed at the Deep Sea Drilling Project headquarters at Scripps Institution of Oceanography. A duplicate is stored at the East Coast Repository at Lamont-Doherty Geological Observatory.

Researchers planning to obtain samples should be cautious in using the Visual Core Description as a guide. Shifting of the sediment while handling the cores, explanation of gas, or shrinkage due to drying may result in discrepancies in position of the desired sediment.

An initial summary of Leg 15 has been published by the scientific staff in Geotimes (1971, v. 16, no. 4, p. 12-17). Additional information has been presented in a special symposium held at the VI Caribbean Geological Conference.

The Initial Reports of the Deep Sea Drilling Project is basically intended to present to the scientific community a compilation of the information gathered on board ship and in laboratories on shore to assist investigators in selecting samples for further study and to present interpretations by the shipboard party that will synthesize the major discoveries into a coherent geologic study. Clearly, it is not an exhaustive scientific document.

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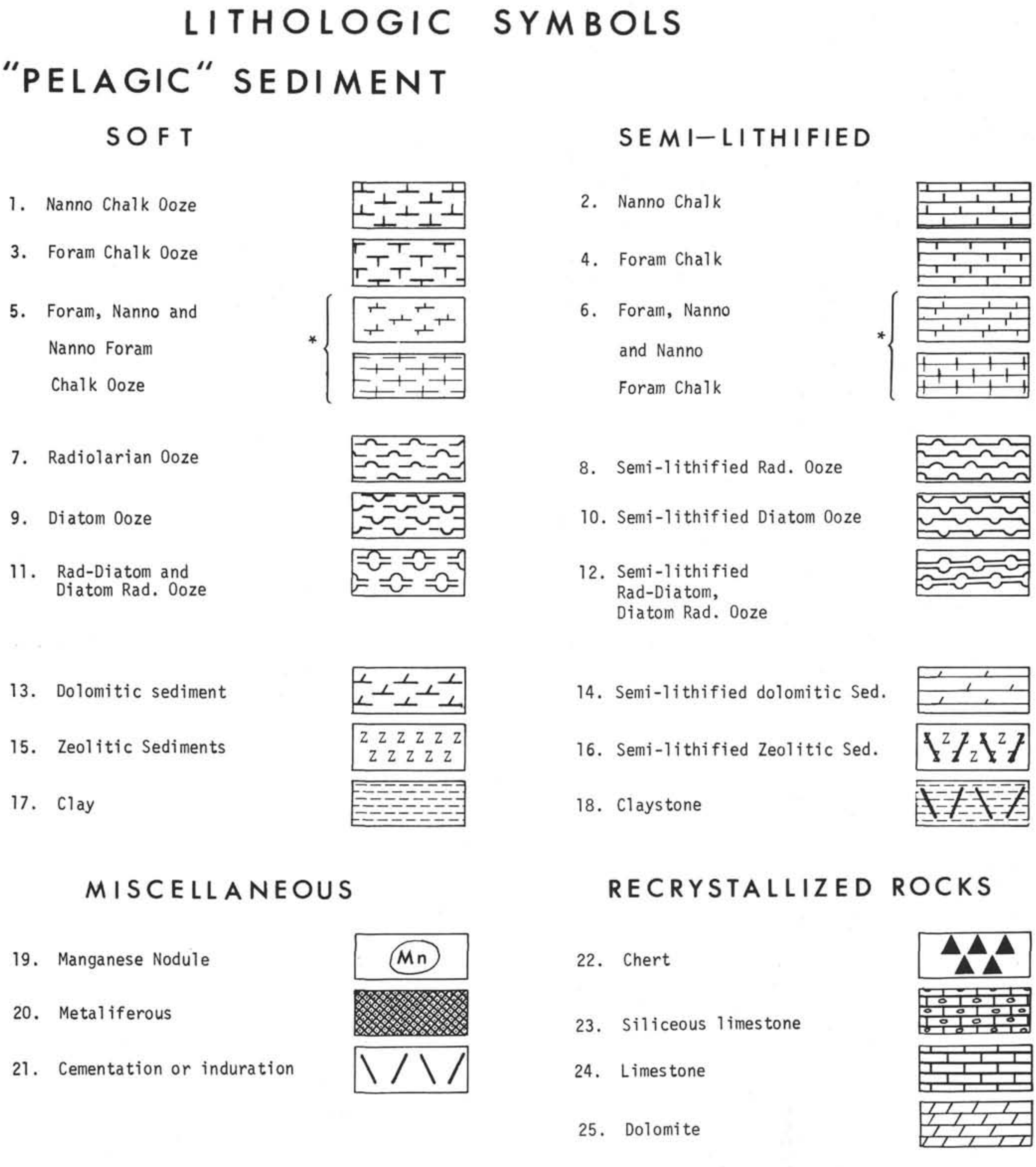


* There are two symbols for the same sediment type. Inadvertently, one symbol was used in the Barrel Descriptions and the other used in the Hole Descriptions.

Figure 6. *Lithologic symbols.*

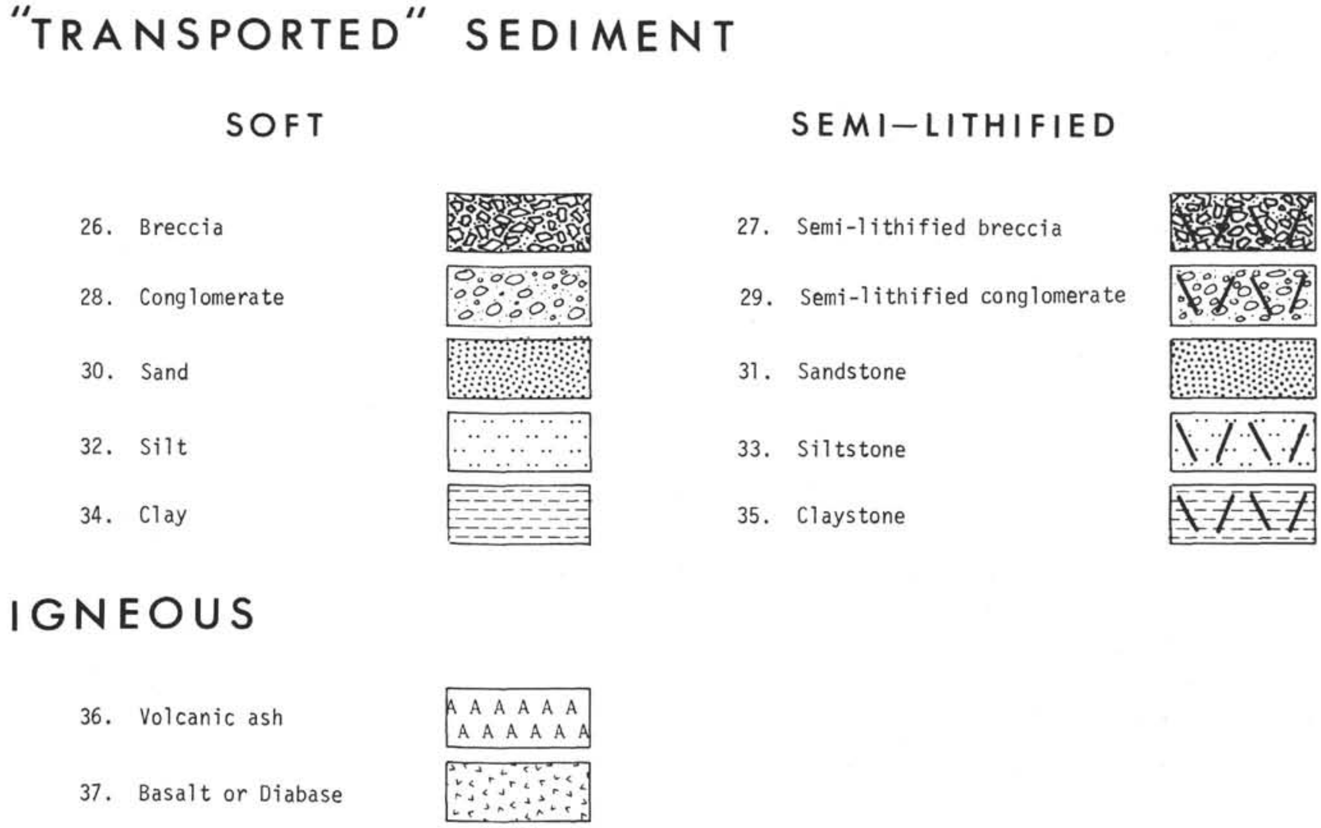
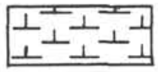
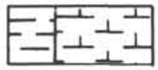
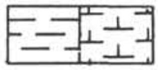
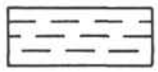
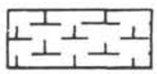
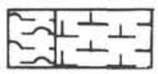
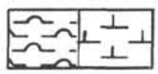
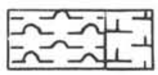
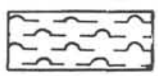
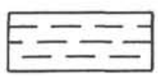
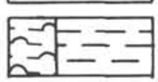
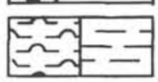
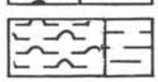
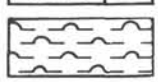


Figure 6. *(Continued)*.

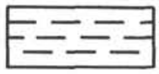
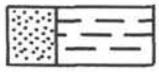
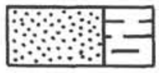
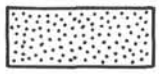
PELAGIC DEPOSITS

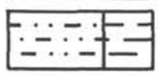
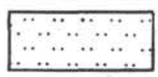
composition (%)		symbol	terminology
Clay	Calcium Carbonate		
0-10	90-100		(*) Chalk Ooze
10-40	60-90		Clay Rich (*) Chalk Ooze
40-70	30-60		Marl Ooze
70-90	10-30		Calcareous (*) Rich Clay
90-100	0-10		Clay
Silica	**Calcium Carbonate**		
0-10	90-100		(*) Chalk Ooze
10-40	60-90		Siliceous (*) Rich (*) Chalk Ooze
40-70	30-60		∘ Siliceous (*) Chalk (*) Ooze
70-90	10-30		Calcareous (*) Rich Siliceous (*) Ooze
90-100	0-10		Siliceous (*) Ooze
Silica	**Clay**		
0-10	90-100		Clay
10-30	70-90		Siliceous (*) Rich Clay
30-60	40-70		∘ Clayey Siliceous (*) Ooze
60-90	10-40		Clay Rich Siliceous (*) Ooze
90-100	0-10		Siliceous (*) Ooze

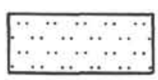
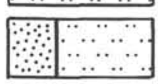
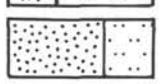
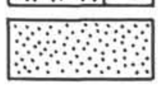
* Sediment names include predominate fossils: eq. nannofossils, foraminifera
∘ Order depends on which is most dominant

Figure 7. *The pelagic sediment name (after Olausson, 1960) and corresponding lithologic symbols used in core and hole descriptions.*

TRANSPORTED DETRITAL

composition		symbol	terminology
Sand	Clay		
0-25	75-100		Clay
25-50	50-75		Sandy Clay
50-75	25-50		Clayey Sand
75-100	0-25		Sand

composition		symbol	terminology
Silt	Clay		
0-25	75-100		Clay
25-50	50-75		Silty Clay
50-75	25-50		Clayey Silt
75-100	0-25		Silt

composition		symbol	terminology
Sand	Silt		
0-25	75-100		Silt
25-50	50-75		Sandy Silt
50-75	25-50		Silty Sand
75-100	0-25		Sand

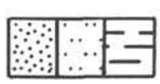
composition			symbol	terminology
Sand-Silt-Clay				
20	40	20		Sand-Silt-Clay
20	20	40		
40	20	20		

Figure 7. *(Continued).*