Harding, B. W., Storms, M. A., et al., 1990
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1. INTRODUCTION AND EXPLANATORY NOTES[1]

Shipboard Engineering and Scientific Parties[2]

INTRODUCTION

Purpose and Background

The engineering technology requirements of the JOIDES science community have grown immensely over the past few years. The complexity of the tasks facing the ODP Engineering and Drilling Operations group is greater than ever before. To achieve the desired result—the accomplishment of heretofore unattainable scientific goals—requires a high level of cooperation between ODP and JOIDES. Key factors in the cooperative effort are improved communications between development engineers and JOIDES panels, more advanced planning (3- to 4-yr plans) including better definition of technical requirements and science goals, more thorough shore- and sea-based test programs, and, finally, adequate funding levels for critical development projects and equipment.

To conduct the necessary seagoing tests, the concept of a dedicated engineering leg had been discussed for many years both within the Ocean Drilling Program and its predecessor, the Deep Sea Drilling Project. The opportunity to utilize *JOIDES Resolution* for testing developmental tools and evaluating new operational techniques, independent of science objectives, was indeed timely. Such things as vessel motion (operational handling and deployment considerations), the marine corrosive atmosphere (rust and corrosion effects on mechanical actuation and hydraulic sealing), and ambient downhole conditions of temperature and pressure are rarely modeled effectively in a shore-based test. Proper testing at sea is critical to development of any efficient and reliable operational system.

Leg 124E, the first ODP cruise dedicated to engineering development, has been an important step in improving ODP seatrials' test programs. It is hoped that the concept of dedicated ship time for engineering testing will continue as a pivotal element in future planning and will help ensure successful hardware development. As such, the complex scientific requirements of the future can likewise be confidently planned for and achieved.

Major engineering objectives of Leg 124E included the following:

1. Shallow-water concept evaluation of the new diamond coring system (DCS).
2. Continued operational evaluation of the developmental navidrill core barrel (NCB).
3. Prototype testing of the pressure core sampler (PCS), phase 1.
4. Performance testing of the newly redesigned extended core barrel (XCB).
5. Performance evaluation of ODP's most advanced coring systems in deep-water chert sequences.
6. Testing and evaluation of logging technology developed by the Borehole Research Group (BRG) of Lamont-Doherty Geological Observatory (LDGO).
7. Evaluation of the deep-water dynamic-positioning capabilities of *JOIDES Resolution*.

Scientific objectives were subordinate to engineering objectives and included the following:

1. Analysis of cores to determine such characteristics as the nature, degree of drilling disturbance, and the physical properties of the recovered material.
2. Acquisition of logging data to augment previous coring results at DSDP Site 453.
3. Dedication of many of the core samples to a geriatric core study to determine changes over time in faunal assemblages, chemistry, and physical properties.

Results of Site Operations

Engineering Results

A total of 15 holes were drilled at 6 sites (Fig. 1; Table 1). The purpose of drilling at these sites was to test the DCS, PCS, NCB, and XCB. Requirements for Sites 772 through 775 included shallow water (1000–1600 m), limited sediment cover (100–200 m), and relatively shallow basement rock. Navigation data for the leg are shown in Table 2 (microfiche, back pocket).

Site 772

The first site, Site 772, was drilled near the mouth of Lingayen Gulf along the west coast of Luzon, Philippine Islands, lat. 16°39′N, long. 119°42′E (Fig. 1). The DCS was not evaluated at that site, since it was determined that basement would not be reached at a shallow enough depth. Thus its deployment was deferred until the next site.

Limited PCS system tests were successful, although further testing was considered essential for a thorough evaluation of the system. The few XCB deployments were considered successful but were deemed inadequate for drawing general conclusions with respect to overall performance. Deployment of an expanded version of the pore-water sampler "colleted" delivery system was successful.

Site 773

Site 773 coincides with ENG-1 site in Luzon Strait, lat. 20°12.3′N, long. 121°39.2′E (Fig. 1). Two holes were drilled at the site.

The first deployment of the DCS occurred at Hole 773B under less than ideal wind and sea conditions. The DCS was evaluated thoroughly despite the fact that the ship's heave amplitude and period exceeded the design parameters of the system. Many positive highlights were noted as well as some improvements to be implemented prior to future shipboard testing. However, some aspects of the system were not tested on Leg 124E, including its ability to drill and recover basement rock. In spite of shortcomings, DCS testing generated a large amount of data that will aid effective development of the system for future ODP operational use.

[1] Harding, B. W., Storms, M. A., et al., 1990. *Proc. ODP, Init. Repts.*, 124E: College Station, TX (Ocean Drilling Program).

[2] Shipboard engineering and scientific parties are as given in the listing of participants preceding the contents.

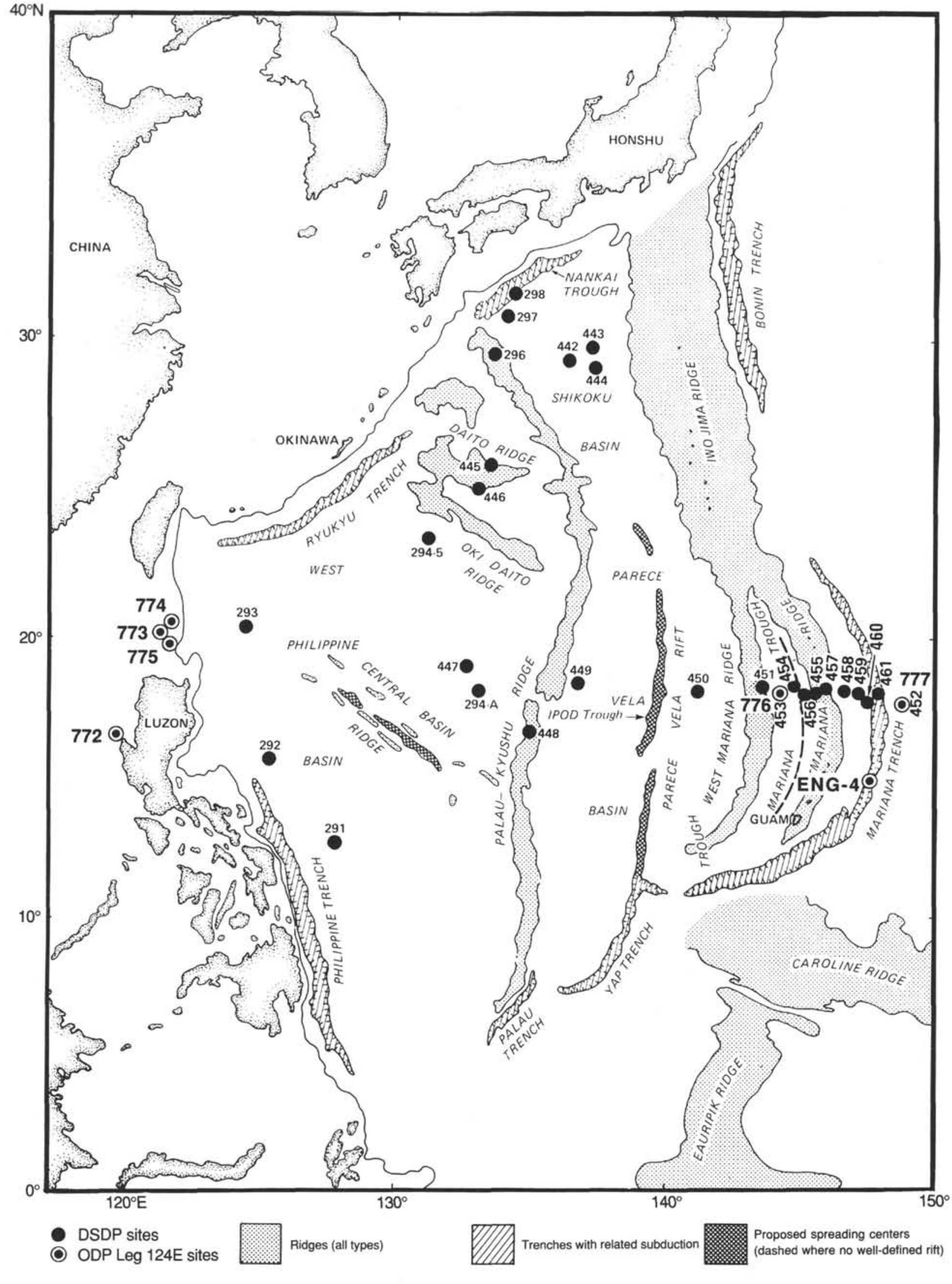


Figure 1. Map of western Pacific region showing DSDP sites and ODP Leg 124E sites. Adapted from Hussong et al. (1982, Fig. 1).

Table 1. Summary of Leg 124E drilling.

Hole	North latitude	East longitude	Water depth[a] (m)	No. of cores	Length cored (m)	Length recovered (m)	Average recovery (%)	Total penetration (m)	Time on hole (hr)
772A	16°39.00′	119°42.00′	1529.5	18	136.20	85.62	62.90	361.00	45.7
773A	20°12.30′	121°39.00′	1593.5	5	13.10	0	0	137.40	29.5
773B	20°12.30′	121°39.20′	1593.5	4	19.10	15.75	82.46	117.40	156.8
774A	20°35.90′	121°44.08′	1084.0	0	0	0	0	37.80	7.3
774B	20°35.90′	121°44.08′	1078.5	0	0	0	0	255.90	33.0
775A	19°51.00′	121°42.98′	495.5	1	6.00	0.31	5.17	6.00	14.3
775B	19°51.00′	121°42.98′	495.5	1	0	0	0	20.50	4.0
775C	19°51.00′	121°42.98′	495.5	1	0	0	0	11.20	7.0
776A	17°54.40′	143°40.95′	4702.5	0	0	0	0	532.45	103.2
777A	17°42.20′	148°41.80′	5800.0	6	48.50	14.69	30.29	49.50	31.9
777B	17°42.20′	148°41.80′	5800.0	5	37.20	38.40	103.23	39.10	15.7
777C	17°42.20′	148°41.80′	5800.0	1	4.00	0.84	21.00	47.40	7.7
777D	17°42.20′	148°41.80′	5800.0	4	9.20	2.36	14.89	59.80	40.1
777E	17°41.80′	148°41.00′	5806.5	2	10.50	0.62	5.90	61.50	49.1
777F	17°41.80′	148°41.00′	5806.5	1	2.50	2.46	98.40	2.50	14.8

[a] From sea level.

Site 774

Site 774, north of Site 773, also was drilled in Luzon Strait, lat. 20°35.9′N, long. 121°44.08′E (Fig. 1). Two holes were drilled at the site in an attempt to find basement and stable hole conditions for testing the DCS. Both holes had to be abandoned because of extreme hole instability. Thus the primary objective was not achieved.

Site 775

Site 775 lies south of Site 773, also in Luzon Strait, lat. 19°51′N, long. 121°42.98′E (Fig. 1). Three holes were spudded at the site, again to seek suitable conditions for testing the DCS. Unfortunately, extremely bad sea conditions, coupled with hole instability, forced the abandonment of all the holes at the site at shallow depths. No developmental tools were deployed.

Site 776

Site 776 coincides with the ENG-2 site at the location of DSDP Site 453, lat. 17°54.4′N, long. 143°40.95′E (Fig. 1). That site was planned for the testing of logging tools developed by BRG/LDGO in a hole drilled for this purpose, so plans for the site involved scientific as well as engineering objectives. Drilling and logging were plagued with problems, just as they were on DSDP Leg 60. The hole was lost when the drill pipe became stuck and had to be severed above the bottom-hole assembly. Thus only minimal tests could be conducted of the qualitative performance of the new hardware and software in the drill pipe after it was shot off and hanging above the seafloor. These limited tests were successful, however.

Site 777

Site 777 coincides with the ENG-3 site at the location of DSDP Site 452, lat. 17°42.2′N, long. 148°41.8′E (Fig. 1). The objective here was an attempt to core a deep-water chert sequence with limited sediment cover by using ODP's latest technology. The NCB system performed better than the XCB in the sequences, despite some failures unrelated to drilling.

ENG-4 Site

We stopped at the location of the ENG-4 site over the Mariana Trench, lat. 15°N, long. 147°30′E (Fig. 1). The lack of time did not allow drilling, but tests were conducted to determine the effectiveness of signals from a deep-water beacon in positioning the ship. The tests were largely successful.

Scientific Results

Scientific objectives, and hence results, of the leg mostly were related to engineering objectives and results and are listed briefly as follows:

1. The cores recovered were described and curated in accordance with standard shipboard procedures (see "Explanatory Notes" section of this chapter). Although not as much core was recovered as we had hoped, these results generally were successful in providing useful information for interpreting effects of various coring systems and drilling parameters. Table 1 summarizes the drilling results of the leg.
2. The logging program planned for Site 776 (ENG-2) was designed to augment previous coring results at DSDP Site 453, where core recovery averaged 39%. Unfortunately, the hole drilled for the logging runs was lost, and logging activity was confined to the testing and calibration of several tools in open drill pipe above the seafloor.
3. Many of the core samples taken were dedicated to a geriatric core study that is being conducted by the ODP Curatorial Group. This study was designed to monitor, on a systematic basis, changes in faunal assemblages, chemistry, and physical properties over an extended period of time, beginning with initial core recovery aboard ship. Following storage of the samples in the Gulf Coast Repository at ODP headquarters, Texas A&M University, repeated subsampling and measurements are continuing. An understanding of how these changes affect the cores is vital to long-term scientific investigations. This study is described in detail in a paper by Mato at the end of a major section containing contributed papers by members of the shipboard party, which follows this chapter.

EXPLANATORY NOTES

Introduction

Standard procedures for drilling operations and preliminary shipboard analysis of the material recovered have been regularly amended and upgraded since the inception of the Deep Sea Drilling Project (DSDP) in 1968, and now under the Ocean Drilling Program (ODP). This portion of the chapter presents information to help the reader understand the data-gathering methods on which various analyses and preliminary scientific conclusions are based and to help shore-based investigators select samples for future analysis. This information concerns primarily shipboard operations and analyses described in the scientific aspects of the Leg 124E site reports (this volume). Preliminary results from shipboard analysis of each individual site are given in the site chapters.

Contributed Papers

Many of the shipboard participants offered, or responded to requests, to submit papers on various aspects of engineering and drilling operations during Leg 124E, including descriptions and evaluations of new or redesigned tools and techniques. These papers are included in a major section of this volume immediately following this chapter. Sincere appreciation is expressed to all who so willingly agreed to contribute in this manner.

Authorship of Site Reports

The various sections of the site chapters were prepared by the following shipboard personnel. Listing in parentheses is in alphabetical order.

Principal Results (site summary) (Rose, Smith)
Background and Objectives (Harding, Huey, Larson, Rose, Scott)
Operations (Harding)
Site Geophysics (Helsley, Larson)
Lithostratigraphy (Baladad, Bryant, Merrill, Rose, Sandvik, Smith)
Paleomagnetism (Helsley)
Physical Properties (Bryant)
Logging Results (Scott)
Summary and Conclusions (Huey, Larson, Rose, Scott, Storms)

Grouped near the back of the volume are summaries of the lithologic core descriptions ("barrel sheets") together with photographs of each core. Coated paper has been used for better reproduction of the photographs.

Shipboard Scientific Procedures

Scientific procedures used in describing cores during Leg 124E follow those given in ODP Technical Note 8, *Handbook for Shipboard Sedimentologists* (Mazzullo and Graham, 1988). We also followed the new sediment-classification scheme, insofar as applicable, which is given in Appendix I of the *Handbook* (Mazzullo et al., 1988). According to this usage, granular sediments have been divided into five major classes: volcaniclastic, siliciclastic, neritic, pelagic, and mixed (Fig. 2). Grain-size determinations follow the Udden-Wentworth scale (Table 2).

Other standard shipboard procedures applicable to our work include drilling and coring techniques; drilling parameters; numbering of sites, holes, cores, and samples; core handling; and sampling methods. The methods and procedures are described in the sections of this chapter that follow and are adapted from recent ODP *Initial Reports* volumes (Shipboard Scientific Party, 1989a, 1989b, 1989c). Methodologies and techniques used in analyzing cores and samples recovered on this leg are described in a contributed paper by Mato entitled "Geriatric Core Investigation on Leg 124E," which appears at the end of a major section immediately following this chapter. Included are descriptions of paleomagnetic, physical-property, and geochemical techniques and analyses.

As no paleontologists were on board during the leg, no age dating was possible. Thus no systematic biostratigraphic discussions are included with the site chapters.

We have prepared no overall chapter on underway geophysics. Instead, this information is given in a separate section in most of the site chapters.

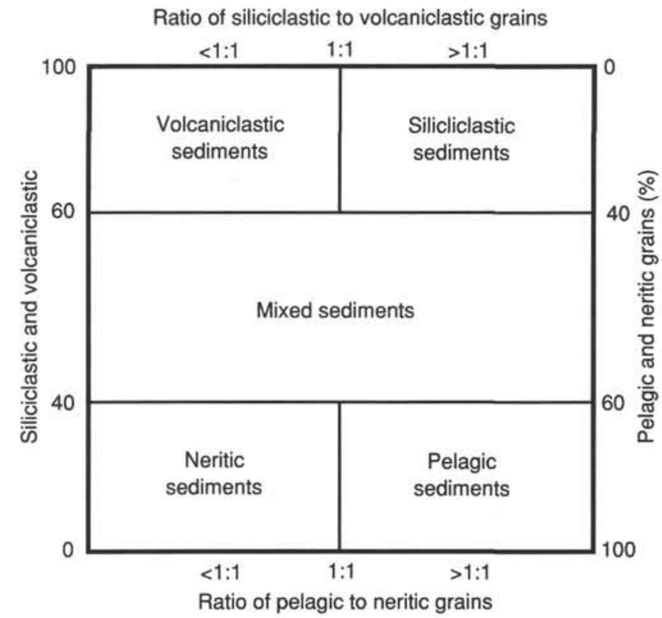


Figure 2. Classes of granular sediments, according to the new ODP classification scheme (Mazzullo et al., 1988).

Numbering of Sites, Holes, Cores, and Samples

ODP drill sites are numbered consecutively from the first site drilled by *Glomar Challenger* in 1968. A site number refers to one or more holes drilled while the ship is positioned over a single acoustic beacon. Several holes may be drilled at a single site by pulling the drill pipe above the seafloor (out of one hole), moving the ship some distance from the previous hole, and then drilling another hole. Depths, when referred to the drilling-platform level (derrick floor), are assumed to be about 10.5 m above sea level.

For all ODP drill sites, a letter suffix distinguishes each hole drilled at the same site. For example, the first hole takes the site number with the suffix A, the second hole with the suffix B, etc. This procedure is different from that used by DSDP (Sites 1–624), but it prevents ambiguity between site and hole designations.

All ODP core and sample identifiers indicate core type. The following abbreviations are used for cores recovered on this leg: H = advanced hydraulic piston core (APC); X = extended core barrel (XCB); M = miscellaneous (representing the diamond coring system); N = navidrill; P = pressure core barrel; W = wash core recovery.

The cored intervals are measured in meters below the seafloor (mbsf). The depth interval of an individual core is the depth below the seafloor at which the coring operation began to the depth at which the coring operation ended. Each coring interval is usually 9.5 m long, which is the usual capacity of a core barrel, but the coring interval may vary in length. On Leg 124E, a 1.5-m (5-ft) interval typically was used with the diamond coring system. Cored intervals are not necessarily adjacent but may be separated by drilled intervals. In soft sediment, the drill string can be "washed ahead," keeping the core barrel in place but not recovering sediment, by pumping water down the pipe at high pressure to wash the sediment out of the way of the bit and up the annulus between the drill pipe and the wall of the hole. If thin, hard layers of rock are present, however, it is possible to get "spotty" sampling of these resistant layers within the washed interval.

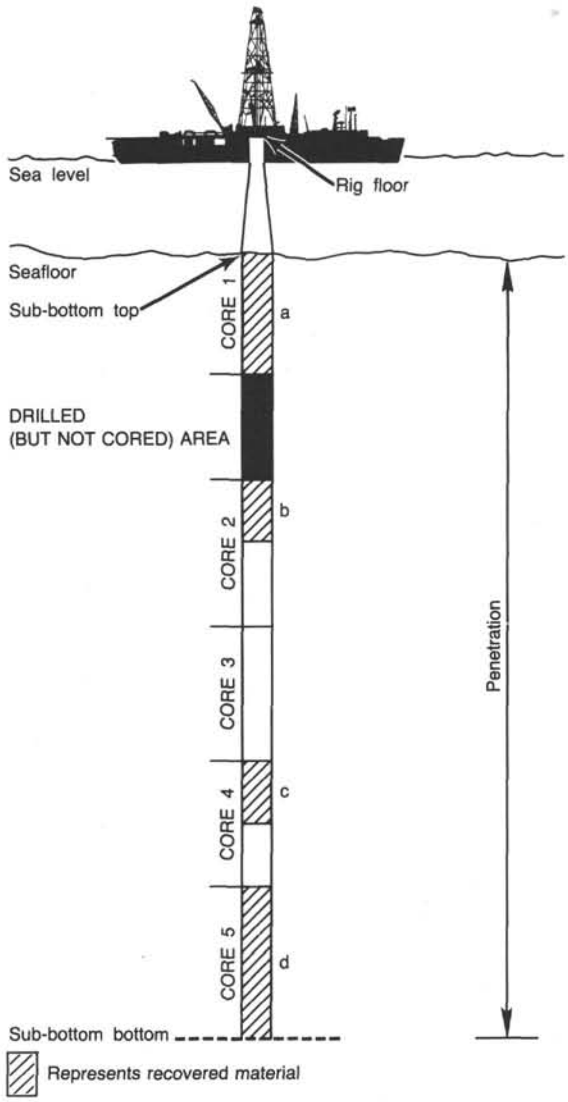
Cores taken from a hole are numbered serially from the top of the hole downward (Fig. 3). Full recovery from a single core

Table 2. Grain-size categories used for classification of siliciclastic sediments (from Wentworth, 1922).

MILLIMETERS	μm	PHI (Ø)	WENTWORTH SIZE CLASS	
		-20		
4096		-12	Boulder (-8 to -12 Ø)	
1024		-10		
256		-8		
64		-6	Cobble (-6 to -8 Ø)	GRAVEL
16		-4	Pebble (-2 to -6 Ø)	
4		-2		
3.36		-1.75		
2.83		-1.5	Granule	
2.38		-1.25		
2.00		-1.0		
1.68		-0.75		
1.41		-0.5	Very coarse sand	
1.19		-0.25		
1.00		0.0		
0.84		0.25		
0.71		0.5	Coarse sand	
0.59		0.75		
1/2 0.50	500	1.0		
0.42	420	1.25		
0.35	350	1.5	Medium sand	SAND
0.30	300	1.75		
1/4 0.25	250	2.0		
0.210	210	2.25		
0.177	177	2.5	Fine sand	
0.149	149	2.75		
1/8 0.125	125	3.0		
0.105	105	3.25		
0.088	88	3.5	Very fine sand	
0.074	74	3.75		
1/16 0.0625	63	4.0		
0.053	53	4.25		
0.044	44	4.5	Coarse silt	
0.037	37	4.75		
1/32 0.031	31	5.0		
1/64 0.0156	15.6	6.0	Medium silt	
1/128 0.0078	7.8	7.0	Fine silt	
1/256 0.0039	3.9	8.0	Very fine silt	MUD
0.0020	2.0	9.0		
0.00098	0.98	10.0	Clay	
0.00049	0.49	11.0		
0.00024	0.24	12.0		
0.00012	0.12	13.0		
0.00006	0.06	14.0		

is normally 9.5 of sediment or rock in a plastic liner (6.6 cm inner diameter), plus a sample about 0.2 m long (without a plastic liner) in a core catcher (CC). The core catcher is a device at the bottom of the core barrel that prevents the core from sliding out when the barrel is retrieved from the hole.

A recovered core is divided into 1.5-m sections, which are numbered serially from the top (Fig. 4). When complete recovery is obtained, the sections are numbered from 1 through 7, with the last section possibly being shorter than 1.5 m. If cores are fragmented (recovery less than 100%), sections are numbered serially and intervening intervals are noted as void, whether or not shipboard scientists believe that the fragments were contiguous *in situ*. Material recovered from the core catcher is placed below the last section when the core is described and then is labeled "CC"; in sedimentary cores it is treated as a separate section.



BOTTOM FELT: distance from rig floor to seafloor

TOTAL DEPTH: distance from rig floor to bottom of hole (sub-bottom bottom)

PENETRATION: distance from seafloor to bottom of hole (sub-bottom bottom)

NUMBER OF CORES: total of all cores recorded, including cores with no recovery

TOTAL LENGTH OF CORED SECTION: distance from sub-bottom top to sub-bottom bottom minus drilled (but not cored) areas in between

TOTAL CORE RECOVERED: total from adding a, b, c, and d in diagram

CORE RECOVERY (%): equals TOTAL CORE RECOVERED divided by TOTAL LENGTH OF CORED SECTION times 100

Figure 3. Diagram illustrating terms used in coring operations and core recovery.

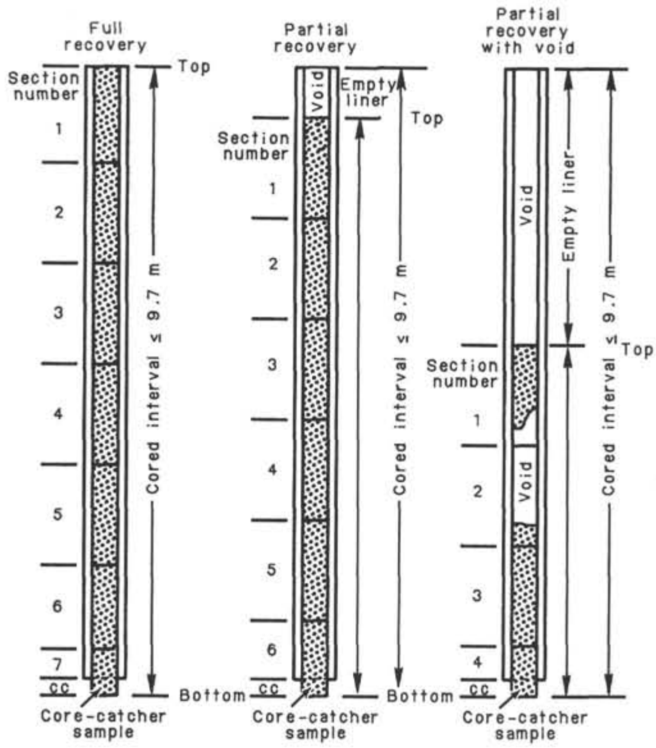


Figure 4. Diagram showing procedure used for cutting and labeling core sections.

When, as is usually the case, the recovered core is shorter than the cored interval, the top of the core is equated with the top of the cored interval by convention to achieve consistency in handling analytical data derived from the cores. Samples removed from the cores are designated by distance measured in centimeters from the top of the section to the top and bottom of each sample removed from that section.

A full identification number for a sample consists of the following information: (1) leg, (2) site, (3) hole, (4) core number and type, (5) section, and (6) interval in centimeters. For example, the sample-identification number 124E-772A-1H-2, 130–140 cm, indicates that a sample was taken between 130 and 140 cm from the top of Section 2 of APC-drilled Core 1, from the first hole (A) drilled at Site 772 during Leg 124E. A sample taken from 8 to 9 cm in the core catcher of this core would be designated 124E-772A-1H-CC (8–9 cm). Sample requests should refer to specific intervals within the core sections rather than to sub-bottom depths.

Core Handling

As soon as a core was retrieved on deck, the core was placed on the long horizontal rack on the catwalk. The core then was marked into section lengths; each section was labeled, and the core was cut into sections. Interstitial-water and organic-geochemistry samples were taken as scheduled. Each section was sealed top and bottom with a plastic cap, blue to identify the top of a section and clear for the bottom. A yellow cap was placed on section ends from which a whole-round core sample had been removed.

The cores then were carried into the core laboratory, and the complete identification was engraved on each section. The length of core in each section and the core-catcher sample were measured to the nearest centimeter; this information was logged into the shipboard core-log database program.

Cores from some holes were allowed to warm to a stable temperature (approximately 3 hr) before they were split. During this time the whole-round sections were run through the gamma-ray attenuation porosity evaluator (GRAPE) device for estimating bulk density and porosity, the *P*-wave logger (PWL), and the cryogenic magnetometer for measuring magnetic susceptibility. After the temperature of the cores had reached equilibrium, thermal-conductivity measurements were made immediately before the cores were split.

Cores were split lengthwise into "working" and "archive" halves. The softer cores were split with a wire, and the harder ones with a saw. Records of all removed samples are kept by the ODP Curator at Texas A&M University. Extracted samples were sealed in plastic vials or bags and labeled with a computer-printed label.

The archive halves of the cores were described visually. Smear slides were made from tiny samples taken from the archive half. No thin sections were made, which ordinarily would have come from the working half, because the thin-section laboratory was being remodeled on this leg. The archive halves were photographed with both black-and-white and color film after having been described.

Both core halves then were put into labeled plastic tubes, sealed, and transferred to cold-storage space aboard the drilling vessel. They now repose in the ODP Gulf Coast Repository at Texas A&M University.

Sediment Core Description Forms ("Barrel Sheets")

Core description forms, or "barrel sheets" (Fig. 5), summarize the data obtained during shipboard analysis of each sediment core, recorded in detail on a section-by-section basis on visual core description forms, or VCD's. Information recorded on the VCD's is available as a searchable database through the ODP Data Librarian. The following sections explain some of the methods used in characterizing cores.

Paleomagnetic and Physical-Property Data

Columns are provided on the core description form, or barrel sheet, to record paleomagnetic results, positions of the samples taken for physical-property analysis, and shipboard results for undrained shear strength (γ), porosity (ϕ), and compressional-wave (*P*-wave) velocity (V). A column also is provided for recording results of any chemical analyses.

Graphic Lithology

Lithologies are shown on the barrel sheets by one or more of the symbols shown in Figure 6. For sediments that are mixtures, the symbols for both constituents are shown divided by a vertical dashed line. Minor lithologies that are very thin are noted in the "Lithologic Description" space but not in the "Graphic Lithology" column.

Drilling Disturbance

Recovered rocks and soft sediments may be slightly to extremely disturbed. The condition of disturbance is indicated in the "Drilling Disturbance" column on the barrel sheets. Symbols for the disturbance categories used for soft and hard sediments are shown in Figure 7.

Sedimentary Structures

The locations and types of sedimentary structures in a core are shown by graphic symbols in the "Sedimentary Structures" column on the barrel sheets (Fig. 7). Distinguishing between natural structures and structures created by the drilling process is sometimes difficult, especially in deeper sections.

Color

Sediment colors were determined by comparison with Munsell soil color charts. Determinations were made immediately after the cores were split and while they were still wet.

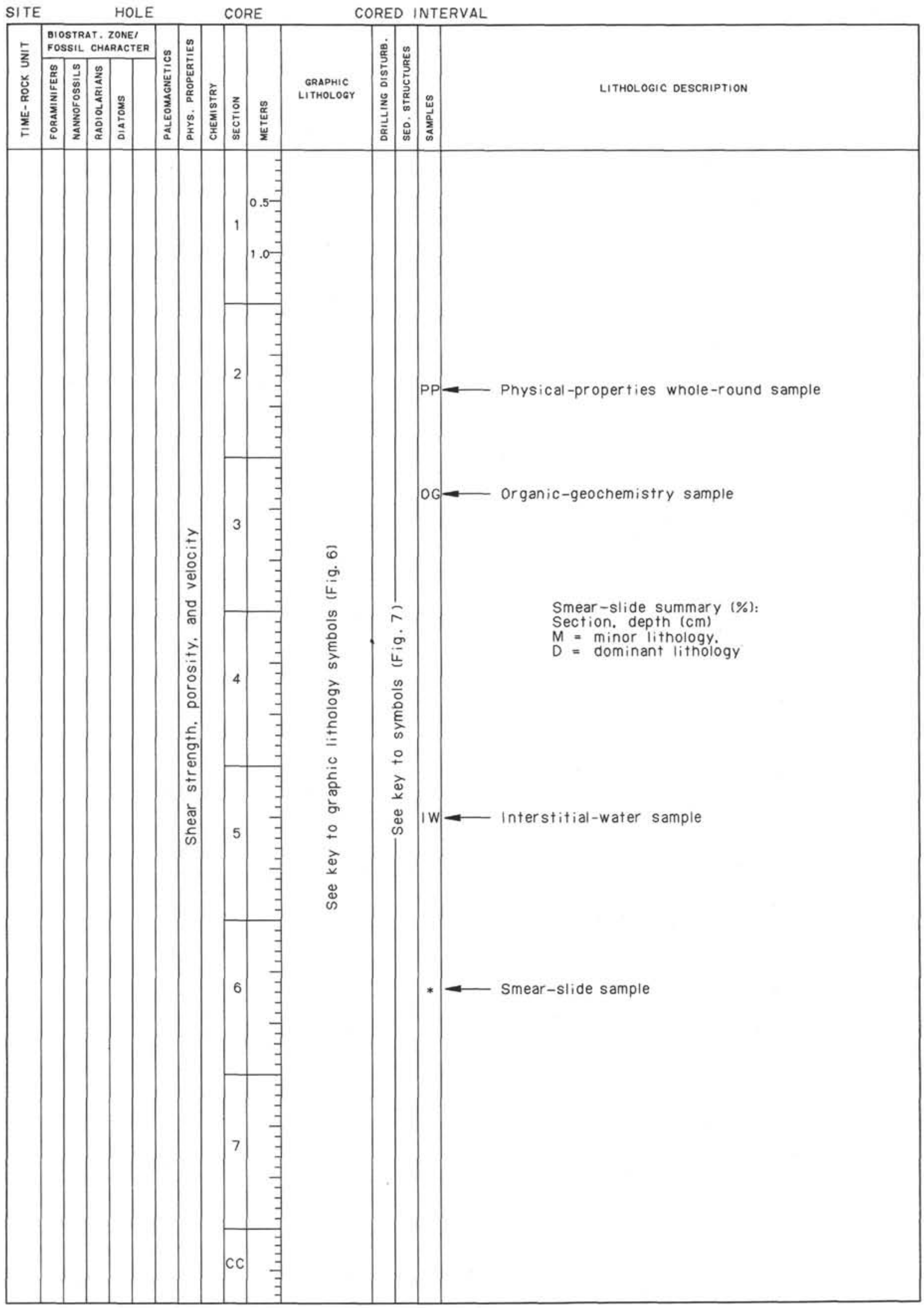


Figure 5. Core description form, or "barrel sheet," for sediments and sedimentary rocks.

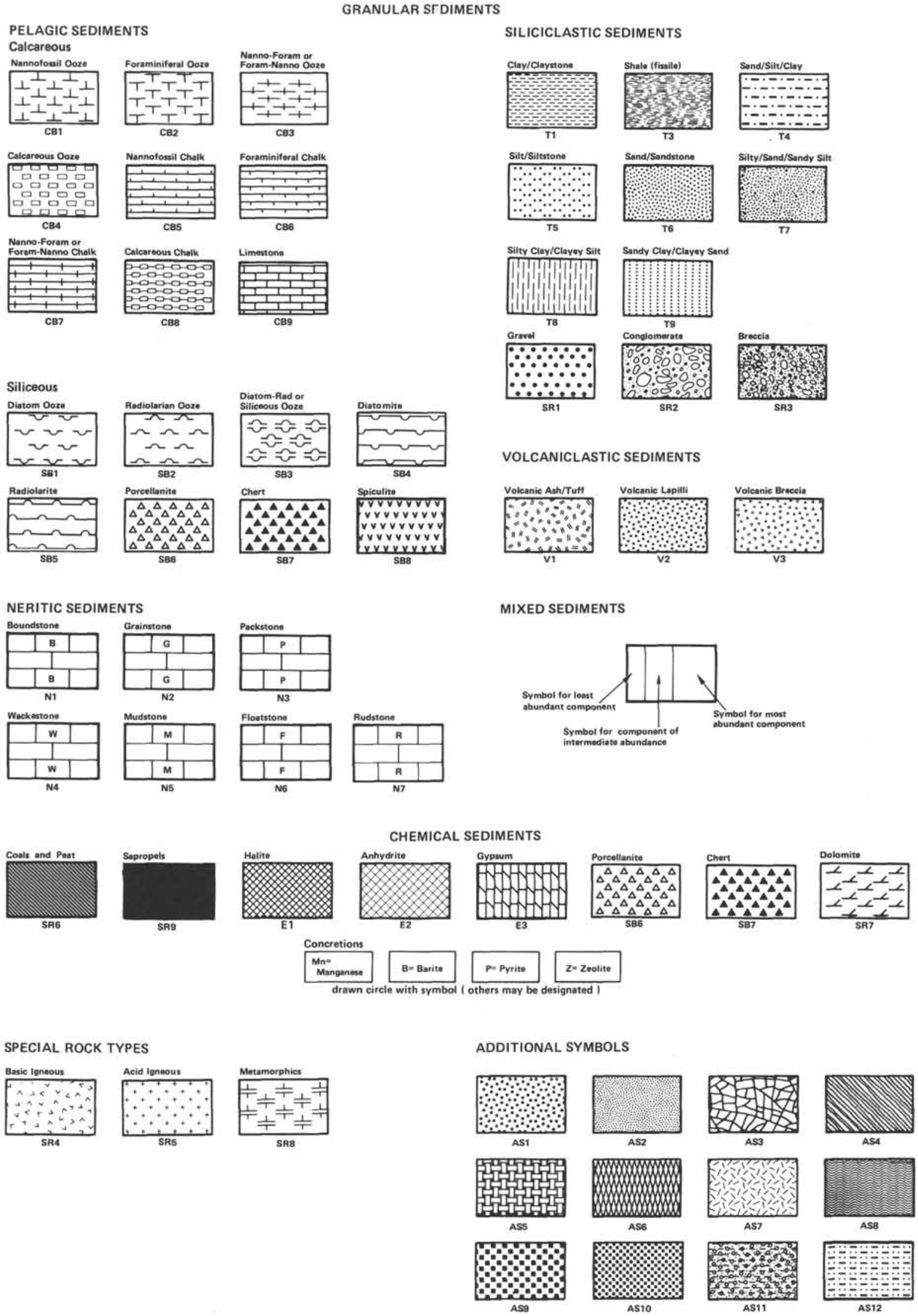


Figure 6. Lithologic symbols used in "Graphic Lithology" column of core description form, or "barrel sheet," for sediments and sedimentary rocks.

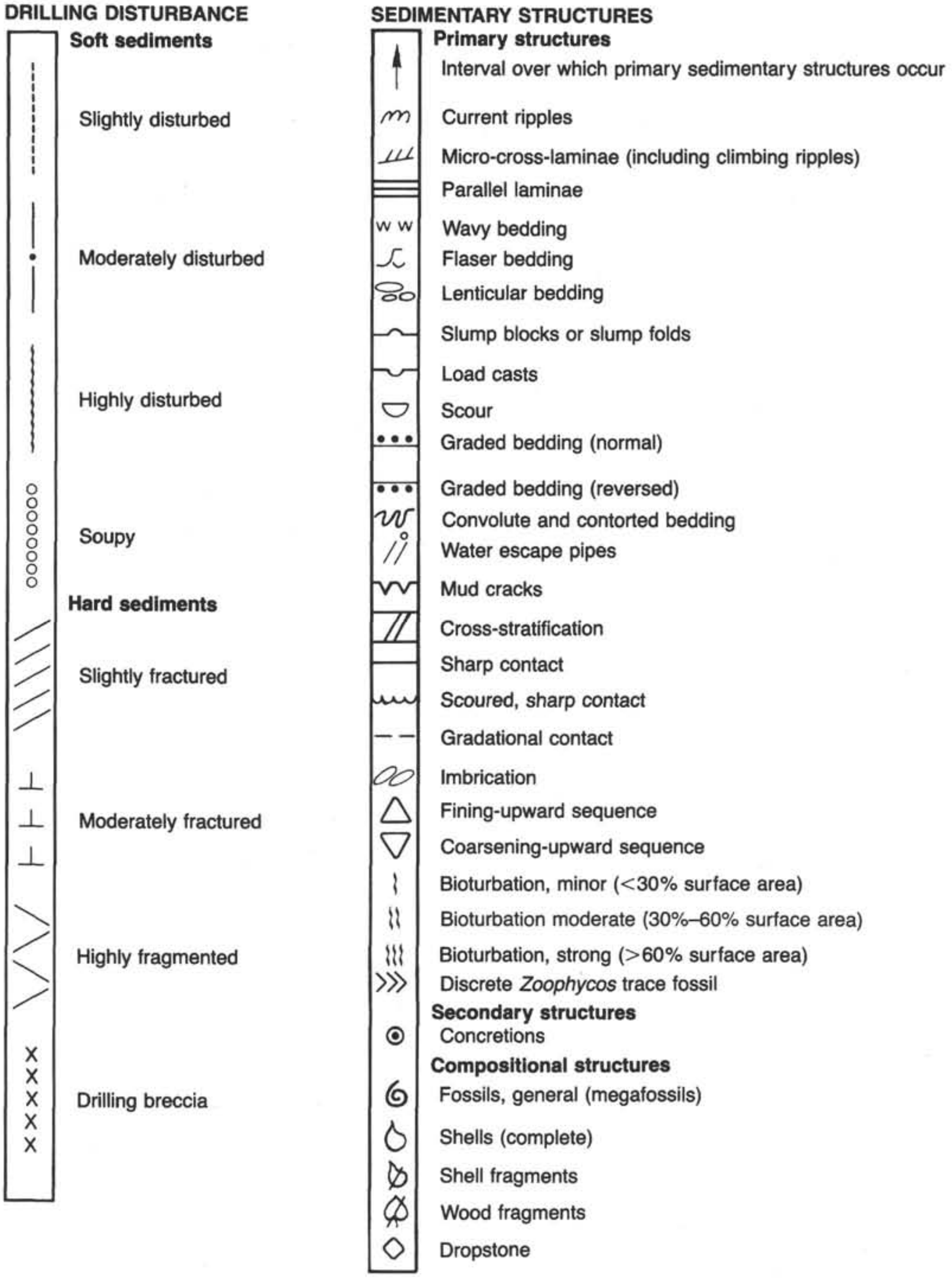


Figure 7. Symbols used in "Drilling Disturbance" and "Sedimentary Structures" columns of core description form, or "barrel sheet."

Smear-Slide Summaries

Smear-slide compositions and the sections and centimeter intervals of all smear-slide samples are listed below the core description on the barrel sheet. The letters *D* and *M* pertain to the lithology of the sample and mean "dominant" and "minor," respectively. Positions of the samples taken for smear-slide analysis are indicated by asterisks on the barrel sheets.

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