2. EXPLANATORY NOTES

ORGANIZATION AND RESPONSIBILITIES FOR AUTHORSHIP

This Initial Report volume is divided into three major sections. The first consists of Introduction, Explanatory Notes, and reports on each of the four sites drilled during Leg 35. The second section consists of more detailed discussions on specialized topics and contains contributions from both shipboard participants and other interested investigators. This section is subdivided into Geological and Geophysical Studies, Geochemical Studies, and Biostratigraphy. The third section contains the summary and conclusions chapter which, in dealing with the regional geology, summarizes and integrates the results of Leg 35 drilling and previous studies in the area.

The authorship of the site summary chapters is shared collectively by the shipboard scientific party, although the ultimate responsibility for their content lies with the two co-chief scientists. Each site chapter follows the same general outline, and individual participants assumed the major responsibility for contributing specific sections. The site chapters are largely based on work initiated aboard ship during Leg 35, however, additional information produced by shore-studies has been incorporated to provide a more complete and accurate report. Some discussions are taken from more detailed chapters by shipboard scientists which are presented in the second section of the volume. When data or conclusions from investigators other than members of the shipboard party are included the appropriate authors are cited by name. We are indebted to the shore-lab contributors who have made a substantial contribution to the volume.

General responsibility for authorship of the individual section is as follows: Background and Objectives, C. Craddock and C.D. Hollister; Operations, C.D. Hollister and C. Craddock; Descriptions and Interpretations of Sediments, B.E. Tucholke, Y.A. Bogdanov, N.T. Edgar, V.N. Zhivago; Igneous Petrology, W. Vennum; Physical Properties, B.E. Tucholke; Interpretation of Seismic Profiles, C.D. Hollister and B.E. Tucholke; Geochemistry, J.M. Gieskes and J. Lawrence; Biostratigraphy, F. Rögl (foraminifers), B.U. Haq (nannoplankton and silicoflagellates), H.-J. Schrader (diatoms), F.M. Weaver (radiolarians); Sedimentation Rates, B.U. Haq; Summary and Conclusions, C.D. Hollister and C. Craddock.

SURVEY AND UNDERWAY DATA

The survey data which formed the basis of Leg 35 site selection was provided by Lamont-Doherty Geological Observatory and are discussed in greater detail in the individual site summary chapters. Seismic surveys were also made by *Glomar Challenger* approaching and leaving the site.

During periods when *Glomar Challenger* was "underway," continuous observations were made of water depth, magnetic field, and subbottom profiles. Underway water depths were recorded on a Gifft precision depth recorder and corrected according to the Matthews' tables to yield the water depth data (given in m) for each site. The magnetic data were collected with a Varian proton magnetometer with the sensor towed 300 meters behind the ship. Readings were taken at 5-min intervals from an analog recorder. The seismic profiling system consisted of two Bolt airguns, a Scripps-designed hydrophone array, Bolt amplifiers, two bandpass filters, and two EDO recorders. The second sweeps, filter settings, gain settings, and airgun size were variable and are recorded on individual profiler records. Seismic profiler records, made while steaming between sites, are reproduced in foldouts in the back cover. All time notations on the underway data are given in Greenwich Mean Time; however, in order to be consistent with drilling logs and other ship's operations, "local time" is used in the text of the site reports.

BATHYMETRIC MAP AND TRACK CHART

A bathymetric map of the Bellingshausen region, contoured by Brian E. Tucholke, is presented as a foldout in the back cover. Data compiled from *Eltanin* cruises 5, 10, 11, 17, 19, 21, 23, 42, 43, *Vema* cruises 16 and 18, *Conrad* cruise 15, and *Glomar Challenger* Leg 35, as well as from Mammerickx, et al. (1974a, b) provided the basis for the map. A chart showing *Glomar Challenger*'s Leg 35 track accompanies the bathymetric map. Time notations shown on the track correspond to those on the seismic profiler records (also presented as foldouts in the back cover).

NUMBERING OF SITES, HOLES, CORES, AND SAMPLES

Drill site numbers run consecutively from the first site drilled by *Glomar Challenger* in 1968. The site number is unique and refers to the hole or holes drilled from one acoustic positioning beacon. Several holes may be drilled at a single locality (site) by pulling the drill string above the sea floor and offsetting the ship, usually 100 m or more, from the previous hole. Holes drilled at a single site take the site number and are distinguished, with the exception of the first hole, by a letter suffix. During Leg 35 only *one* hole was drilled at each site and consequently the same number designates both site and hole at a single locality.

The cored interval is the interval below the sea floor, measured from the point at which coring for a particular core was begun to the point at which it was terminated. This interval is usually 9.5 meters long (length of a core barrel), but may be shorter if difficult drilling conditions are encountered. Cored intervals need not be contiguous and may be separated by "drilled intervals." In soft sediments, the drill string can be "washed ahead" without recovering core material by applying sufficiently high pump pressure to wash sediment out of the way of the bit. In hard rocks a center bit, which fills the opening in the bit face, can replace the core barrel if drilling without core recovery is desired. Drilling or washing ahead are usually imposed by time limitations during drilling of thick, monotonous lithologies, and/or when a major objective of the hole is to reach and sample specific underlying units.

Cores are numbered sequentially from the top down. Full recovery comprises 9.28 meters of sediment or rock in a 6.6-cm-diameter plastic liner and a short sample (≤20 cm) obtained from the core catcher—a multifingered device at the bottom of the core barrel which prevents cored materials from sliding out during core-barrel recovery. Cores are cut into 1.5-meter sections which are also numbered sequentially from top to bottom. Because the core barrel is 9.28 meters rather than 9 meters long, it is possible that in addition to six 1.5-meter sections a segment of up to 28 cm may be recovered. When this occurs the segment is designated the "0-section" and comprises whatever is "left over" at the *top* of the core after six 1.5-meter sections have been cut.

More frequently, recovery is less than 100%. In case of partial recovery, we cannot determine where in the cored interval the sediment was originally located, and the following conventions are employed for the purpose of consistency and convenience in routine data handling. If the sediment is contiguous the recovered material is arbitrarily placed in the top of the cored interval, and sections are numbered sequentially (starting with Section 1 at the top) for as many 1.5-meter sections as needed to accommodate the length of core recovered. Sections are cut starting at the base of the recovered material, hence the "void" which occurs when the recovered sediment is not evenly divisible by 1.5, falls at the top of Section 1. Centimeter intervals in Section 1, however, are measured from the top of the section, rather than the top of the sediment. If recovery is partial, core segments are separated, and shipboard scientists believe the sediment was *not contiguous*, sections are numbered sequentially, and the intervening sections are noted as "void." The core-catcher sample is described in the visual core descriptions beneath the lowest section regardless of whether or not it is contiguous. Core labeling is graphically depicted in Figure 1.

Sample intervals are designated in centimeters from the top of the core section from which the sample was extracted. Thus, a full sample designation contains leg, site (or hole), core, section, and interval designations which may be abbreviated as follows: 35-322-4-1, 122-124 cm.

HANDLING OF CORES

The following determinations are made while the core section is "in the round," prior to longitudinal splitting:

1) Weight of core section to determine mean bulk density measurement;

2) Gamma ray attenuation porosity evaluator (GRAPE) analysis to determine bulk density and porosity;

3) Sonic velocity determination using a Hamilton frame.

The cores are then split longitudinally into "work" and "archive" halves. Samples, including those for grain size, X-ray mineralogy, water content, carbon/carbonate, geochemical, and paleontological determinations, are extracted from the "work" half. The archive half is described including notation of color, texture, structure, and composition of the various lithologic units. Smear slides are prepared and examined microscopically to provide texture and composition data.

The core and smear-slide descriptions (obtained onboard ship) and grain size, carbon-carbonate, X-ray mineralogy determinations (obtained from shore-based labs) serve as the basis for the visual core descriptions presented in this volume.

CORE DESCRIPTIONS

Descriptions and photographs of the Leg 35 cores are presented in the site reports (Chapters 3-6, this volume).

The basic data contained on the core descriptions are as follows.

Graphic Lithology

A key to lithologic symbols is presented in Figure 2.

Sediment Name

Classification and nomenclatural rules applied during Leg 35 are presented in the appendix at the end of this chapter.

Color

Color notations are based on the standard Munsell or GSA color charts. Colors were determined during shipboard examination of the sediment or rock immediately after the core sections were split. Frequently colors in sediments rich in organic material will fade or disappear with time. Colors particularly susceptible to fading are purple, light and medium tints of blue, light bluish-gray, dark greenish-black, light tints of green, and pale tints of orange. These colors change to white or yellowish-white or pale tan.

Composition

Mineral identifications are made onboard ship from smear slides and determinations are listed under "Composition" on the core descriptions. Smear-slide estimates of mineral abundances were based on area of the smear slide covered by each component. Accuracy may approach 99% for very distinctive minor constituents; however, for major constituents accuracy of 80%-90% is considered very good.

Biostratigraphy

Siliceous microfossils served as the primary means of age determination during Leg 35. Indeed, the occurrence of calcareous microfossils was very limited, although they proved to be extremely valuable in the few thin intervals in which they were found. Diatom zonation is based on that of McCollum (1975); radiolarian zones are those of Chen (1975) and Hayes and Opdyke (1967). Foraminiferal zonation is primarily based on Bolli (1966) and Berggren (1969), and nan-

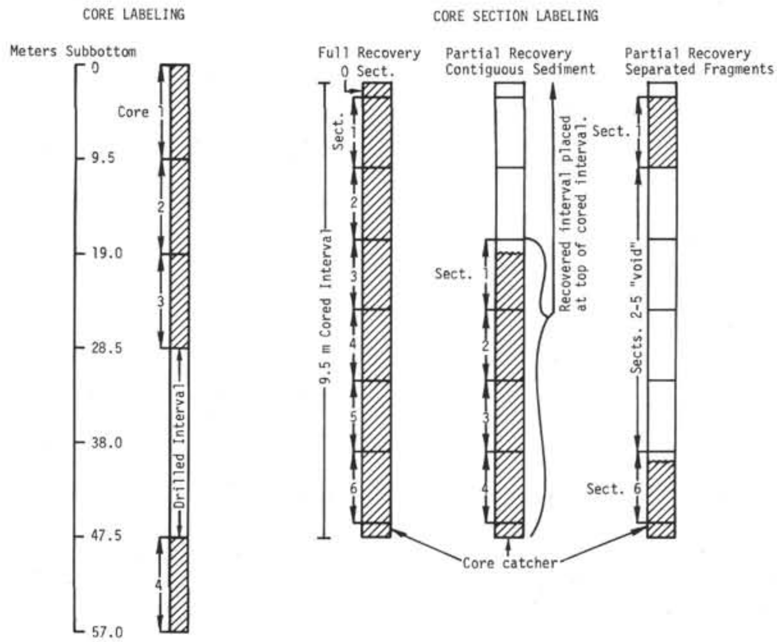

Figure 1. *Procedures for labeling cores and core sections.*

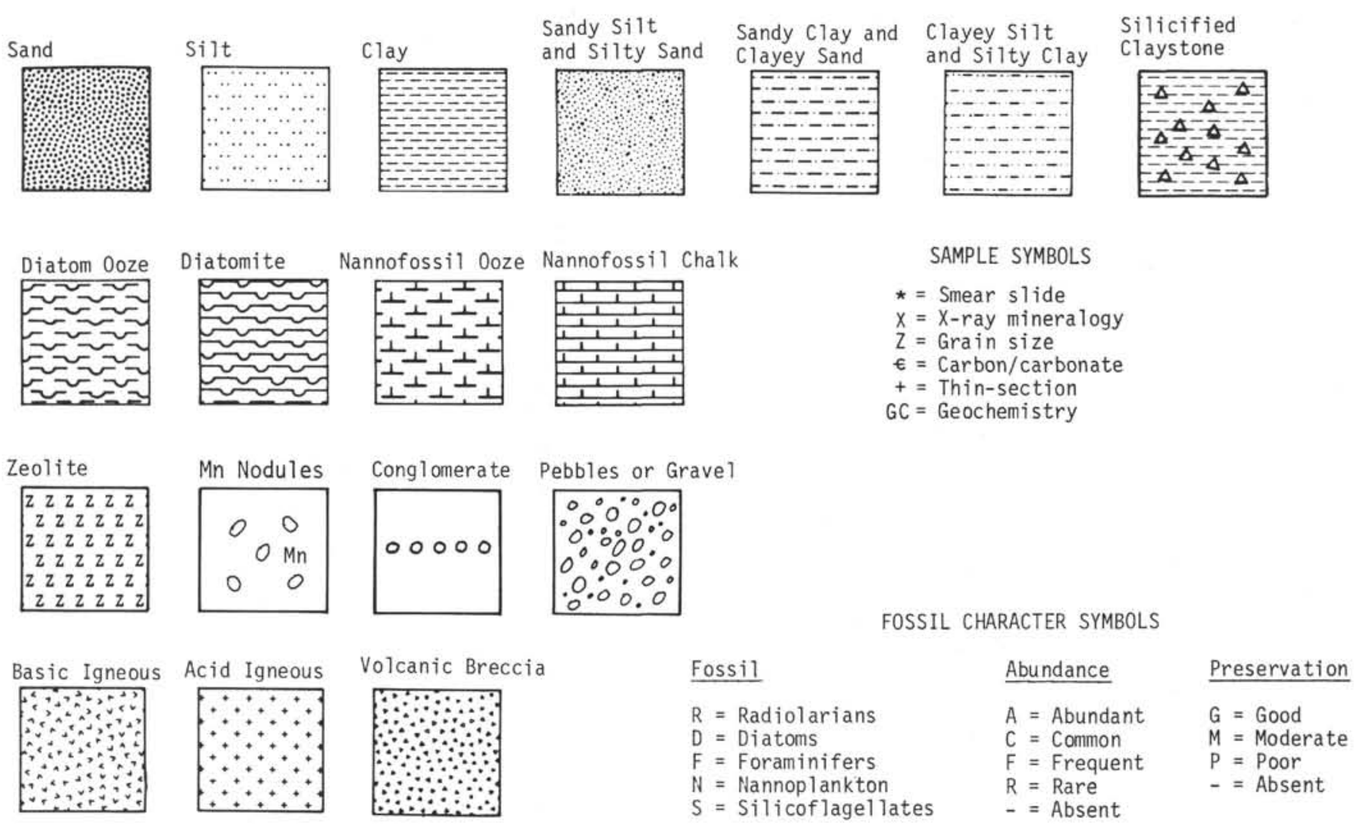

Figure 2. *Key to lithologic and biostratigraphic symbols used on visual core descriptions.*

noplankton zonation is that of Martini (1970) and Martini and Worsley (1970). Figure 3 (modified from Hayes, Frakes, et al., 1975) shows correlation of the siliceous microfossil zones, paleomagnetic stratigraphy, and absolute and relative time scales.

A key to the fossil character symbols which appear on the core descriptions is given in Figure 5.

Core Disturbance and Downhole Contamination

Rotary drill coring quite often results in varying degrees of disturbance of the cored sediments. Cores may exhibit slight bending of bedding contacts (slightly deformed) to extensive bending resulting in near-vertical bedding planes (highly deformed). In extreme cases, bedding may be completely disrupted to produce a "drilling slurry" or "drilling breccia." Degree of disturbance is noted on the core descriptions (deformation column), and symbols used to denote degree of disturbance are shown in Figure 4.

Downhole contamination results when rock fragments are washed or dragged downhole and become incorporated into cores at levels below their proper stratigraphic position. Displaced manganese nodules can usually be recognized; displaced chert, rock fragments, and pebbles present more of a problem, but can sometimes be recognized as an overlying lithology or from the fossil content. The presence of known downhole contaminants is recorded on the core descriptions.

X-Ray Mineralogy

Semiquantitative determinations of the mineral composition in bulk samples, 2 to 20 μm, and <2 μm fractions are performed on shore according to the methods described in the reports of Legs 1 and 2 and in Appendix III of Volume 4, Initial Reports of the Deep Sea Drilling Project. The mineral analyses of the 2 to 20 μm and <2 μm fractions are performed on $CaCO_3$-free residues.

Determinations for the bulk samples only are tabulated on the core logs. The total percentage of amorphous scattering (noncrystalline, unidentifiable material) is shown in addition to the crystalline, identified fraction. Note, however, that the percentage of identified minerals is based only on the crystalline component which is summed to 100%.

Carbon-Carbonate

Sediment samples are analyzed at the DSDP sediment lab on a Leco 70-Second Analyzer following procedures outlined in Volumes 9 and 18 of the Initial Reports of the Deep Sea Drilling Project. Accuracy and precision of the results are as follows:

Total carbon	±0.3% (absolute)
Organic carbon	±0.06% (absolute)
$CaCO_3$	±3% (absolute)

A legend for understanding presentation of the carbon-carbonate data is given on the sample core description (Figure 5).

Percent $CaCO_3$ was also determined onboard ship by the "Karbonat Bombe" technique (Müller and Gastner, 1971). In this simple procedure a sample is powdered and treated with HCl in a closed cylinder. Any resulting CO_2 gas, and thus CO_2 pressure, is proportional to the $CaCO_3$ content of the sample. Application of the calibration factor to the manometer reading (×100) yields percent $CaCO_3$. The system is calibrated with a standard sample of 100% $CaCO_3$ and the CO_2 pressure measured on an attached manometer. Percent error can be as low as 1% for sediments high in $CaCO_3$ and generally an accuracy 2%-3% error can be obtained. The $CaCO_3$ values obtained by the "Karbonat Bombe" technique are noted as "shipboard determinations" on the core descriptions to distinguish them from those obtained with the Leco 70-Second Analyzer.

Grain Size

Sand-silt-clay distribution is determined from 10-cc sediment samples collected at the time the cores were split and described.

Shepard's (1954) sediment classification is used (see appendix, this chapter) and the sand, silt, and clay boundaries are based on the Wentworth (1922) scale. Thus the particle size of the sand, silt, and clay fractions ranges from 2000 to 62.5 μm, 62.5 to 3.91 μm, and less than 3.91 μm, respectively.

Standard sieve and pipette methods were used to determine the grain size distribution. The sand-size fraction is removed by wet sieving using 63 μm sieve, and the silt and clay fractions were analyzed by standard pipette analysis. Sampling depths and volumes were calculated using equations derived from Stokes settling velocity equation (Krumbein and Pettijohn, 1938).

A legend for understanding the grain size data is given on the sample core description (Figure 5).

MEASUREMENTS OF PHYSICAL AND GEOCHEMICAL PROPERTIES

The physical properties measured during Leg 35 were bulk density, water content, porosity, and sonic velocity. Densities and porosities were determined from the total weight and volume of each core section, the "syringe" technique (weighing and oven drying of a known volume—0.5-1.0 cc—of sediment), and by the gamma-ray attenuation porosity evaluator (GRAPE). Water content was measured primarily by the "syringe" technique. A Hamilton frame was utilized to measure sonic velocities. In soft sediments sonic velocities were measured parallel to bedding plane. Velocities of sediment or rock pieces which were sufficiently indurated to allow their removal from the core liner were measured both parallel and perpendicular tc bedding. Shipboard procedures for physical property measurements are described more fully in Tucholke et al. (this volume).

Alkalinity, *p*H, and salinity were measured routinely on interstitial water samples taken from soft sediments. Sediments were squeezed with a hydraulic press similar to that described by Manheim (1966). Surface sea water, which during drilling is circulated through the drill string, was also measured, to give an indication of possible contamination. The procedure employed has been described in detail, including photographs and diagrams of equipment, in the Explanatory Notes of Volume 23 of the DSDP Initial Reports (Whitmarsh, Weser, Ross, et al., 1974).

During Leg 35 a special attempt was made to relate the geochemistry of the interstitial water with that of the bulk sediment. An extensive sampling program was conducted to provide shore-based investigators with bulk sample. The results of the individual studies are presented in Part III (Geochemical Studies) of this volume.

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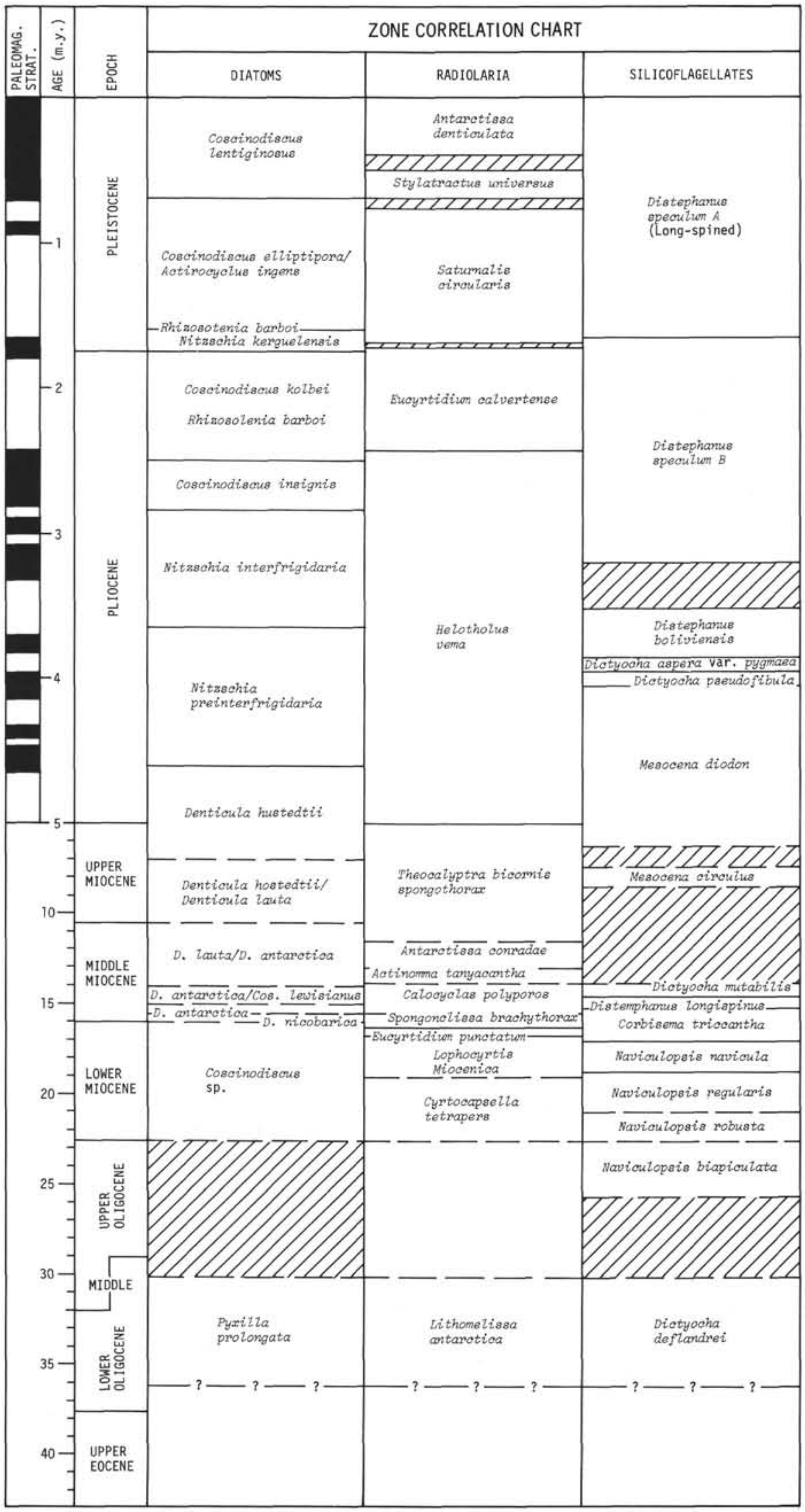

Figure 3. *Correlation of biostratigraphic zones and paleomagnetic stratigraphy (after Hayes, Frakes, et al., 1975).*

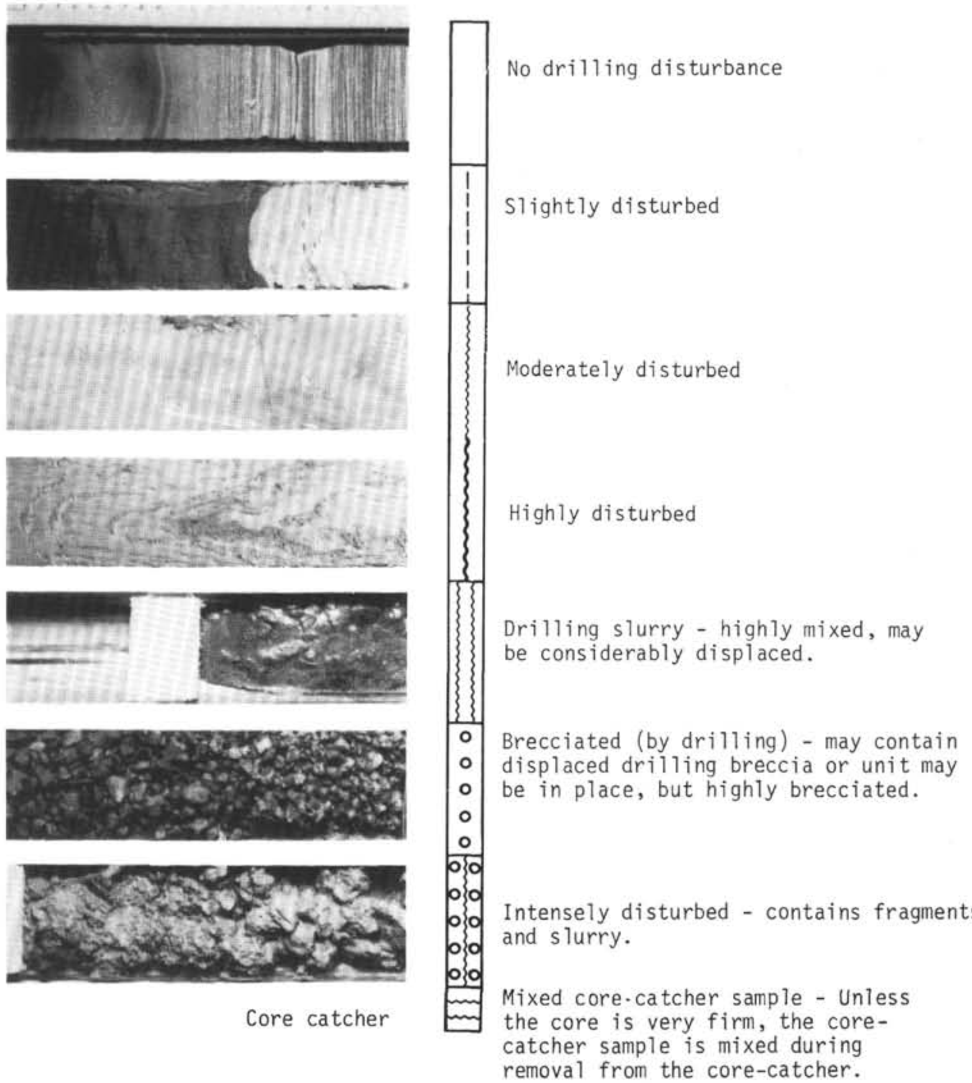

Figure 4. *Key to drilling deformation symbols used on visual core descriptions.*

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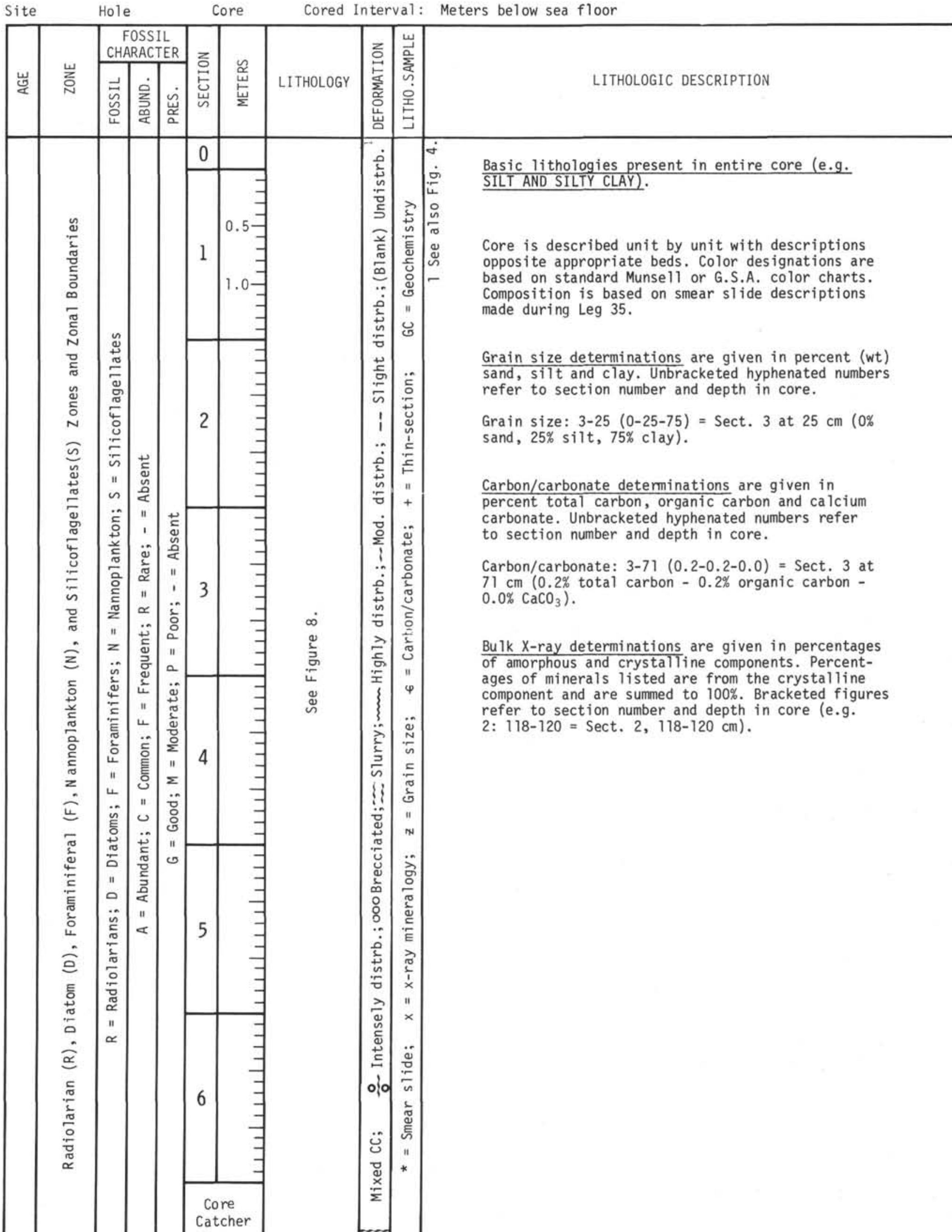


Figure 5. *Explanation of core description.*

CLASSIFICATION AND NOMENCLATURE RULES

I. Rules for class limits and sequential listing of constituents in a sediment name

A. Major constituents

1. Sediment assumes name of those constituents present in major amounts (major defined as >25%). See example in rule IA3.
2. Where more than one major constituent is present, the one in greatest abundance is listed farthest to the right. In order of decreasing abundance, the remaining major constituents are listed progressively farther to the left.
3. Class limits when two or more major constituents are present in a sediment are based on 25% intervals, thusly: 0-25, 25-50, 50-75, 75-100.

Example illustrating rules IA and IB and the resulting sediment names:

% Clay	% Nannos	
0-25	75-100	= Nanno ooze
25-50	50-75	= Clayey nanno ooze
50-75	25-50	= Nanno clay
75-100	0-25	= Clay

B. Minor constituents

1. At the discretion of the geologist, constituents present in amounts of 10-25% may be prefixed to the sediment name by the term **rich**.
Example: 50% nannofossils, 30% radiolarians, 20% zeolites would be called a **zeolite-rich rad nanno ooze**.
2. At the discretion of the geologist, constituents present in amounts of 2-10% may be prefixed to the sediment name by the term **bearing**.
Example: 50% nannofossils, 40% radiolarians, 10% zeolites would be called a **zeolite-bearing rad nanno ooze**.

C. Trace constituents. Constituents present in amounts of <2% may follow the sediment name with addition of the word **trace**. This again is at the discretion of the geologist.

II. Specific rules for calcareous and siliceous tests

A. Nannofossil is applied only to the calcareous tests of coccolithophorids, discoasters, etc.

B. The term **calcareous** or **siliceous**, depending on skeletal composition, is applied where no attempt is made to distinguish fossils as to major subgroup. Thus, if no percent estimate is made, a mixture of radiolarians, diatoms, and silicoflagellates would be called **siliceous ooze**. Where this distinction is made, the appropriate fossil name is used.

C. Fossil tests are not qualified by a textural term unless very obviously redeposited.

D. Abbreviations, as nanno for nannofossil, rad for radiolarian, etc., may be used in the sediment name.

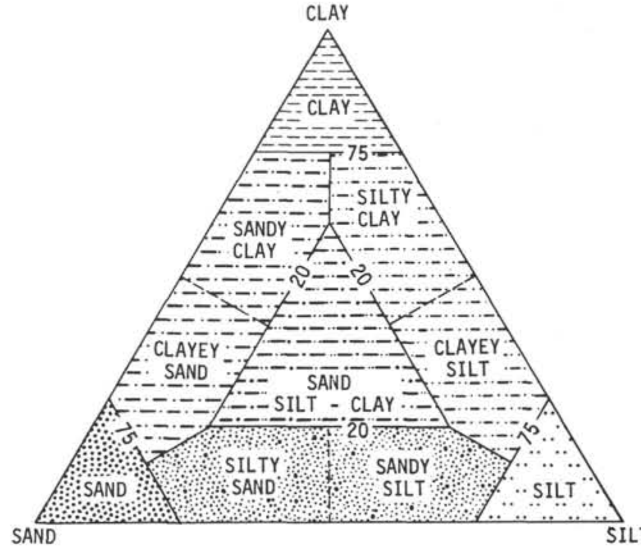
E. The term **ooze** follows a microfossil taxonomic group whenever it is the dominant sediment constituent.

F. Usage of the terms **marl** and **chalk** to designate amounts of microfossils, 30-60% and >60% respectively, as used by Olausson (1960) and others, is dropped. The term **chalk** is retained to designate a compacted calcareous ooze.

III. Clastic sediments

A. Clastic constituents, whether detrital, volcanic, biogenous or authigenic, are given a textural designation. When **detrital**[1] grains are the sole clastic constituents of a sediment, a simple textural term suffices for its name. The appropriate term is derived from Shepard's triangle diagram. The textural term can be preceded by a mineralogical term when this seems warranted. Such mineralogical terms are applied as per rules IA and B.

[1]**Detrital** = all clastic grains derived from the erosion of preexisting rocks except for those of biogenous, authigenic, or volcanic origin.



TEXTURAL TRIANGLES

Textural classification of clastic sediments, after Shepard (1954).

B. When the tests of a fossil biocoenosis or authigenic and detrital grains occur together, the fossil or authigenic material is not given a textural designation (as per rule IIC). However, the detrital material is classified texturally by recalculating its size components to 100%. With the presence of other constituents in the sediment, the detrital fraction now requires a compositional term.

C. Clastic volcanics
Redeposited pyroclastics also become a clastic component. They are again recognized by the term **volcanic** and receive a textural term such as **gravel, sand, silt**, etc. It is particularly difficult at times to differentiate between **volcanic sand** (i.e., transported by tractive mechanisms) and **crystal ash** (i.e., direct outfall resulting from explosion of a volcano).

D. Clastic authigenic constituents
Where authigenic minerals are recognized as being a redeposited constituent, they are given a textural designation in addition to their mineral names.

IV. Volcanic and authigenic constituents

A. Volcanic constituents
Pyroclastics are given textural designations already established in the literature. Thus, **volcanic breccia** = >32 mm, **volcanic lapilli** = <32 mm to >4 mm, and **volcanic ash** = <4 mm. It is at times useful to further refine the textural designations by using such modifiers as **coarse** or **fine**. An ash wholly, or almost wholly, of glass shards is termed **vitric ash**.

B. Authigenic constituents

1. Authigenic minerals enter the sediment name in a fashion similar to that outlined under rules IA and B. Normally, as with a fossil biocoenosis, the authigenic minerals are not given a textural designation and texture.
2. The terms **ooze** and **chalk** are applied to carbonate minerals of all types using the same rules that apply to biogenous constituents.

V. Color

A. Color is not formally part of the sediment name. However, its employment for sediment description is important particularly as it provides one of the criteria used to distinguish **pelagic** and **terrigenous** sediments.

B. Common usage dictates that it is no longer expedient to employ the term **red** for sediments (*usually* pelagic) which are various shades of red, yellow, and brown. The proper color designation should be used.