# 2. EXPLANATORY NOTES

## RESPONSIBILITIES FOR AUTHORSHIP

The authorship of site chapters is collectively the shipboard scientific party with ultimate responsibility lying with the two chief scientists. L. D. Kulm is senior author for Sites 172, 174, 175, 176, and 177; R. von Huene for Sites 173, 178, 179, 180, 181, and 182.

Chapters 3 to 13 present data and discussions on the holes drilled. Each site chapter follows the same pattern. The first section, site background and objectives, was written by the chief scientist responsible for that site (see above). The lithologic summaries were written by J. R. Duncan, D. J. W. Piper, R. M. Pratt, and O. E. Weser. Sections on biostratigraphy were written by J. C. Ingle, S. A. Kling, L. F. Musich, H. J. Schrader, and S. W. Wise. The sections on physical properties were written by R. von Huene. Correlation of reflective records and the stratigraphic column, summary and conclusions, as well as the appendix on drilling operations, were written by the chief scientist responsible for that site.

The interpretations of individual authors have been retained in the section for which they were responsible. Therefore, conflicting interpretations are sometimes apparent between a particular section and the summary. Authorship of papers dealing with special topics (Chapters 14 to 31) and the summary chapters (Chapters 32 and 33) is cited in the text.

## SHIPBOARD AND SHORE LABORATORY SCIENTIFIC PROCEDURES

The shipboard and shore laboratory scientific procedures as well as the method of handling and numbering cores is the same as that described in Chapter 2 of Volume 12 of the Initial Reports.

### Sediment Classification[1]

For many decades the first comprehensive classification of marine sediments as devised by Murray and Renard (1884) was more than adequate. Then at an accelerating pace, matching that of ever expanding surface coring programs, revisions to this classification have been made. One of the more durable recent revisions has been that of Olausson (1960). It had proven to be particularly adaptive for those whose needs are satisfied by a rather generalized categorization of sediments.

However, a new dimension to the study of marine sediments has been initiated in recent years by the many boreholes drilled on the *Glomar Challenger*. This dimension is marked by repeated penetrations of the entire oceanic stratigraphic record and by detailed ship and shore-based examinations of the more than 10 miles of sediment (as of Leg 25) thus far recovered. For the first time it allows specific and detailed comparisons to be made in the deep marine realm between either parts of or the entire geologic record. Consequently, it was not surprising to find upon studying the first 17 volumes of the ICD that the Olausson classification had found little usage by the various shipboard scientific groups. These groups either rejected this classification or devised modifications to it.

Based upon this same study, it is also apparent that none of these classifications have found general favor. Because of this and as there is a need to develop continuity in the ICD volumes, a new classification devised by O. E. Weser was used for the first time on Leg 18. It has since been tested on all subsequent legs (to Leg 27 as of this writing). Continual minor modifications to this classification have been made after Leg 18, but the basic principles embodied in it have survived application to a broad range of sediment types.

The classification was devised so as to be adaptable to any study requiring a thorough description of sediments and therefore particularly suitable for DSDP needs. Basically descriptive in character, yet recognizing major genetic aspects as well, it attempts to encompass in the sediment name all the important constituents present. It indicates their relative importance and at the same time distinguishes between compositional and textural aspects. The classification utilizes, almost entirely, terminology in common usage and sets class limits easily manipulated in a statistical fashion. Finally, it attempts to develop a degree of sophistication compatible with present-day techniques of sediment study.

#### 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:

| % Zeolites | % Nannos | |
|---|---|---|
| 0-25 | 75-100 | = Nanno ooze |
| 25-50 | 50-75 | = Zeolitic nanno ooze |
| 50-75 | 25-50 | = Nanno zeolitite |
| 75-100 | 0-25 | = Zeolitite |

B. Minor constituents

1. Constituents present in amounts of 10-25% prefixed to the sediment name by the term **RICH**.

[1] O. E. Weser, Deep Sea Drilling Project, Scripps Institution of Oceanography, La Jolla, California.

Example: 50% nannofossils, 30% radiolarians, 20% zeolites is called a **zeolite-rich rad nanno ooze.**

2. Constituents present in amounts of 2-10% prefixed to the sediment name by the term **BEARING.**
   Example: 50% nannofossils, 40% radiolarians, 10% zeolites is 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 procedure is optional.

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 family, order, species, etc. Where this distinction is made, the appropriate fossil name is used.

C. Noncurrent-transported fossil tests are not qualified by a textural term.

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[2] grains are the sole clastic constituents of a sediment, a simple textural term sufficies for its name. The appropriate term is derived from Shepard's (1954) triangle diagram (see Figure 1). 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.

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. For this purpose the term **detrital** is employed, which enters the sediment name as per rules IA and B.

C. Clastic fossil tests

1. Redeposited fossil tests became a clastic component and are given a textural designation similar to detrital grains. Now, however, the textural term is preceded by the appropriate terms identifying the fossil constituents as per rules IA and B.
2. Rarely complexities arise when a detrital admixture accompanies a redeposited fossil test admixture. Again, the term **detrital** is used to embrace the detrital fraction.

D. 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.

E. Clastic authigenic constituents

Where authigenic minerals are recognized as being a redeposited constituent, they are given a textural designation in addition to their species name in the manner set forth for biogenous clastics (rule IIIC).

IV. Volcanic and authigenic constituents

A. Volcanic constituents

1. 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.**

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. The color designation *always* precedes the sediment name.

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.

VI. General comments

A. Sediments are not formally divided into the two groups, pelagic and terrigenous, by the sediment classification. This distinction is left to be made on an informal basis.

B. The distinction between clastic and nonclastic fossil material is often not clear in the deeper pelagic realm. Therefore, fossil material receives a textural designation if, and only if, there is evidence of obvious and significant current transport. Similar consideration applies to volcanic material.

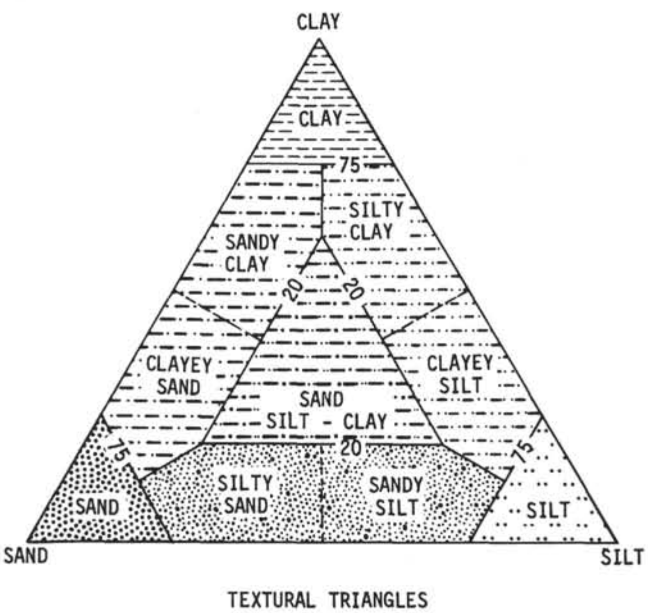


Figure 1. *Textural terms and symbols used in Volume 18.*

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

The policy of sediment terminology used in this volume was to utilize names derived from the above sediment classification throughout the site chapters, including core and site summary forms. Where used on the forms, all sediment names are in capital letters. For individual contributions in Parts II and III, authors were at liberty to use other terminologies if they so desired.

### Smear Slide Descriptions

On the core forms the compositional aspect of a sediment name reflects the visual estimation of various sediment constituents as derived from smear slide examination. These estimations are quantified by percentage values which are listed to the nearest 1 percent. They are, in this manner, somewhat misleading insofar as errors in percentage values of 10 percent or more can easily occur. However, the accuracy of visual estimation is such that numerical values can provide a sharper resolution of compositional variations than an alternative approach of using a letter code. In addition, although the *amount* of change in numerical values may at times not be real, the fact that there is a change is real and reflects trends of increase or decrease in constituents. Such trends are of inestimable value in providing a basis for interpolating or extrapolating where geologic control is poor.

Textural designations on core forms were initially derived from shipboard smear slide descriptions. These were later updated by results from shore lab seive and pipette analyses. These analyses have an accuracy of ±1 percent for sand and ±2½ percent for silt and clay fractions.

### Lithologic Symbols

Accompanying the introduction of the sediment classification to the DSDP volumes is the employment of a new set of lithologic symbols. These symbols and their method of employment has continued, with only minor modification, through all volumes subsequent to Volume 18 (i.e., Volumes 18 to 26). The basic sediment symbols thus employed are as shown in Figure 2.

These symbols have been put on all core and site summary forms. Where complex lithologies occur, instead of superimposing symbols, each constituent is represented by a vertical bar. The width of each bar corresponds to the percentage value of the constituent it represents in the manner shown on Figure 3. It will be noted that the class limits of the vertical bars correspond to these of the sediment classification. With this system of graphical representation all major and the **rich** portion of the minor constituents can be shown. The **bearing** (2-10%) part of the minor constituents is shown by the overprinting of an appropriate letter or symbol. Each letter or symbol corresponds to a specific constituent as shown on Figure 4.

Thus, all major and minor constituents can be graphically shown in the lithologic columns. In addition, their relative proportions can be determined in these columns. It is also possible, by using the rules of the Leg 18 sediment classification, to determine the sediment name by reading the lithologic columns. An exception to the last statement occurs for clastic sediments. As both texture and composition could not be simultaneously represented by symbols, it was decided that only their textural qualities would be shown.

### Core Forms

All pertinent descriptive data derived from ship and shore-based studies are incorporated on the core forms. It was the philosophy to refrain from incorporating genetic or other interpretive aspects on these forms, relegating such information to the written text in the site chapters.

The lithologic data which is on the core level is opposed on facing pages with photographs on the section level.

At some drill sites a detailed grain-size profile of various sedimentation units was considered pertinent. Such a profile was particularly useful in illustrating the presence or absence of graded bedding for coarser terrigenous beds, as well as providing a visual estimation of the sand, silt, and clay ratios and bed thicknesses of coarse units. This profile which was drawn only on the core level is reproduced to the right of the lithologic sample column.

### Deformation

Four degrees of drilling deformation were recognized as follows:

| | |
|---|---|
| Slightly deformed | Highly deformed |
| Moderately deformed | Soupy |

The criteria used in defining these degrees of deformation was that slightly deformed sediments exhibit a slight bending of bedding contacts whereas extreme bowing defines moderate deformation. For highly deformed strata, bedding is completely disrupted and/or at times has vertical attitudes with possible diapirism. Soupy intervals usually are highly water saturated and lose practically all aspects of bedding. In intervals of alternating hard and soft beds, such deformation will be characterized by brecciated fragments of the former, surrounded by viscous to soupy flowage of the latter.

### Procedures Used in Physical Properties Measurements

Measurements of bulk density and porosity were made using the Gamma Ray Attenuation Porosity Evaluator and comparative measurements were provided by wet and dry weights of a given sediment volume. The standard shipboard procedures were followed and these have been described in previous volumes (e.g., Volumes 4, 6, 12). Departures from these procedures that proved effective in improving precision are described in the appendix to Chapter 26. Results given in the core summaries have been computed using the Whitmarsh iterative method (Whitmarsh, 1972).

Laboratory measurements of compressional wave velocities were made according to standard shipboard procedures except that the material was removed completely from the core liner for the measurement. Sonobuoy measurements were attempted in order to provide comparative measurements, but the receiving system was not operating sufficiently well to obtain useful records.

The greatest single factor affecting the usefulness of physical property measurements is core disturbance. The internal checks on precision made during the cruise showed that when properly selected, samples of undisturbed core gave consistent results and that drilling disturbance commonly caused errors of 20 percent. The precision of routine physical measurements made on Leg 18 are the same as those of other legs.

## REFERENCES

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Murray, J. and Renard, A.F., 1884. System of Classification. Proc. Roy. Soc. Edinburgh. **12**, 515.

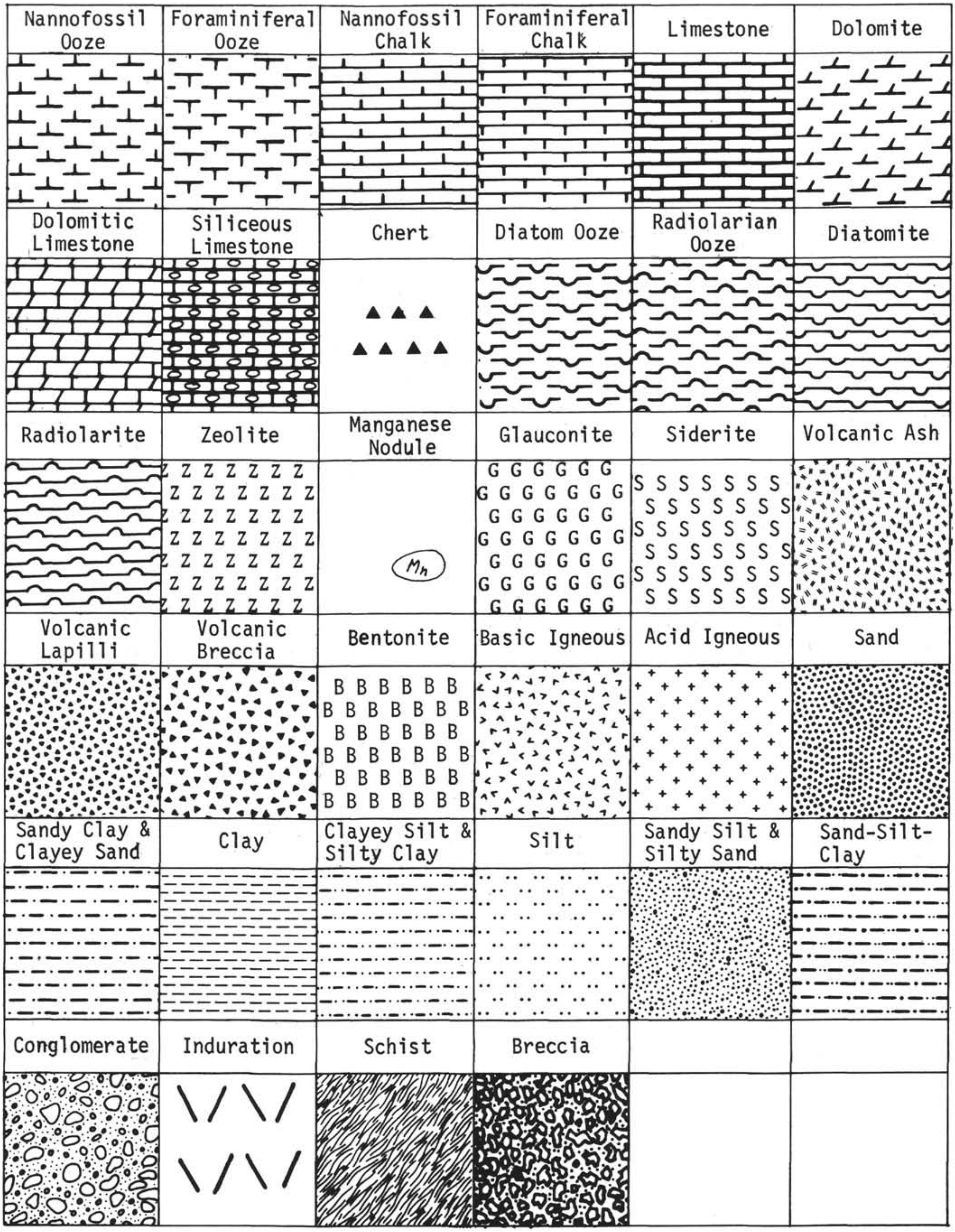


Figure 2. *Lithologic symbols used on core and site summary forms.*

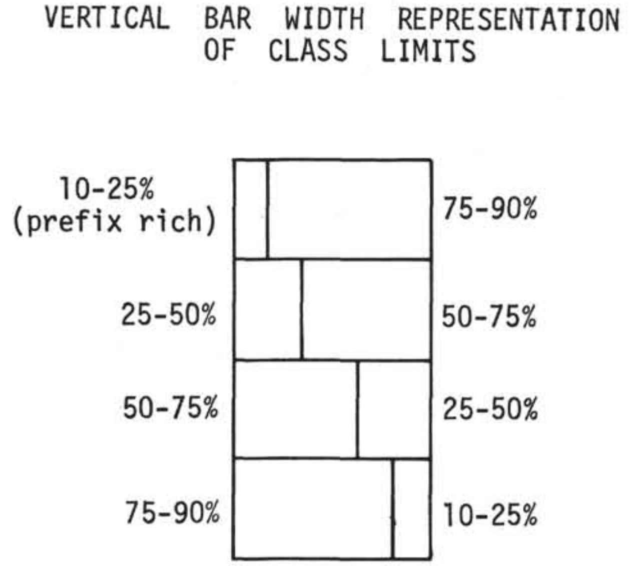


Figure 3. *Vertical bar width representation of class limits.*

F = Foraminifera
N = Nannofossils
D = Diatoms
R = Radiolarians
A = Ash
Z = Zeolite
G = Glauconite
▲ = Chert
Mn = Manganese nodule
⬬ = Erratic or pebble

Figure 4. *Letters and symbols used in lithologic column to represent constituents present in amounts of 2 to 10 percent (i.e.,* **bearing** *constituents).*

Olausson, E., 1960. Studies of Deep-Sea Cores. Rept. Swedish Deep-Sea Exped. **8**, Sediment Cores from the Mediterranean Sea and the Red Sea No. 6.

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