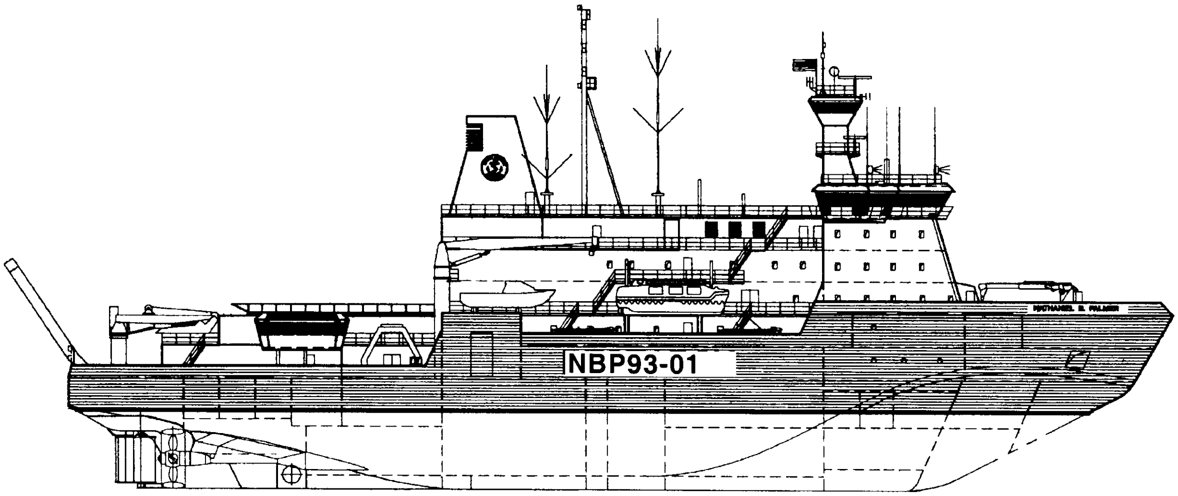
SEDIMENT DESCRIPTIONS
for
R/V *NATHANIEL B. PALMER*
CRUISE 1, 1993



Antarctic Marine Geology Research Facility Contribution No. 2

FLORIDA STATE UNIVERSITY
Tallahassee, Florida

SEDIMENT DESCRIPTIONS
for
R/V *NATHANIEL B. PALMER*
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DESCRIPTIONS OF SEDIMENT RECOVERED BY THE R/V *NATHANIEL B. PALMER*, UNITED STATES ANTARCTIC PROGRAM CRUISE 1, 1993

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INTRODUCTION

This volume contains the descriptions of sediments recovered by the R/V *Nathaniel B. Palmer* during its maiden coring cruise in 1993 (herein referred to as NBP93-1). During February and March, 1993, the R/V*Nathaniel B. Palmer* occupied thirteen coring stations, eleven on the Larsen Ice Shelf and two in the Powell Basin (Table 1 and Figs. 1-2). A total of 4 piston cores, 4 trigger cores, and 5 gravity cores were retrieved during the cruise.

The sediments are curated at the Antarctic Marine Geology Research Facility, Florida State University, Tallahassee, Florida. This facility contains an extensive collection of Antarctic and subantarctic sediments retrieved by coring, dredging, trawling, and grab sampling from a number of research cruises and vessels, and other research initiatives, including: forty-seven cruises of the USNS *Eltanin* (Goodell, 1964, 1965, 1968; Frakes, 1971, 1973; Cassidy et al., 1977a), five cruises of the ARA *Islas Orcadas* (Cassidy et al., 1977b; Kaharoeddin, 1978; Kaharoeddin et al., 1979, 1980, 1982), more than 13 cruises of the USCGC *Glacier* (Goodell et al., 1961; Anderson et al., 1981; Kellogg et al., 1981; Kaharoeddin et al., 1983, 1984, 1988; Bryan, 1992a; 1992b; 1993), nine cruises of the R/V *Polar Duke* (Domack, 1992; Bryan and Pospichal, 1993; Stravers et al., 1993; Hovan and Janecek, 1994a, b, c, and d; Janecek, 1995a), five cruises of the R/V *Nathaniel B. Palmer* (this report; Janecek, 1995b; and unpublished data), the Dry Valley Drilling Project (DVDP) (Dry Valley Drilling Project, 1974, 1975, 1976; McGinnis, 1979; Torii, 1981), the Ross Ice Shelf Project (RISP) (Clough and Hansen, 1979; Webb, 1978, 1979), the Eastern Taylor Valley Project (ETV) (Elston et al., 1981, 1983; Robinson, 1983, 1985; Robinson and Jaegers, 1984; Robinson et al., 1984), the Cenozoic Investigations in the Western Ross Sea Project (CIROS-1, CIROS-2) (Barrett, 1982, 1985, 1987; Barrett et al., 1985; Pyne et al., 1985; Robinson et al., 1987), and collections from miscellaneous vessels operating in the Southern Ocean (*Anton Brun, Robert Conrad, Hero*, and *Vema*).

This volume includes a summary of the scientific objectives of cruise NBP93-01, a table and several maps of station locations, a discussion of core recovery and processing, an explanation of laboratory descriptive procedures, lithologic and smear slide descriptions of piston, trigger, and gravity cores, and several appendices containing sample request and sample distribution information.

R/V *NATHANIEL B. PALMER,* CRUISE 1, 1993

The objectives and preliminary results of cruise NBP93-01 have been summarized by Sloan and Lawver (1993) and are outlined briefly here. Excellent ice conditions allowed the R/V *Nathaniel B. Palmer* to explore a previously unsurveyed area of the Larsen Ice Shelf to the south of the Antarctic Circle. Over 2000 km of underway geophysical data, including bathymetry, magnetics, gravity, and single-channel seismic data were collected during the cruise (see Figs. 1 and 2 for trackline and core locations) and thirteen cores (including trigger cores) were recovered (Table 1). The areas cored included the 300-meter deep Larsen Ice Shelf, the upper slope west of the Shelf, and the center of the Powell Basin in 3400 m of water. Coring was attempted as close as 200 m to the active ice sheet on the Larsen Ice Shelf. The recovery of 13 cores was modest, with core lengths ranging from 36 to 417 cm. Most of the cores were taken along profiles that extend from the ice shelf to the upper slope. Preliminary shipboard examination of the cores revealed a medium-soft, olive-brown diamict several centimeters thick that is underlain by a dark gray, firm diamict unit that proved difficult to penetrate. Both units include variable fractions of sand, pebbles, and cobbles interpreted as allocthonous ice-rafted debris. Well-preserved benthic and planktonic foraminifera were observed in most cores.

Table 1. NBP93-01 coring statistics

Station ID	Core Type	Latitude (°S)	Longitude (°W)	Depth (m)	Length (cm	TC length (cm)
NBP93-01-01	Piston	62° 10.00’	50° 20.00’	3375	n/r	108
NBP93-01-02	Gravity	66° 14.18’	57° 57.44’	332	139	n/r
NBP93-01-03	Gravity	66° 13.94’	58° 14.42’	339	36	n/r
NBP93-01-05	Gravity	66° 12.27’	59° 09.81’	338	110	n/r
NBP93-01-06	Gravity	66° 13.24’	59° 51.78’	349	114	n/r
NBP93-01-08	Gravity	66° 44.11’	58° 47.53’	339	50	n/r
NBP93-01-10	Piston	65° 46.19’	56° 28.44’	330	226	21
NBP93-01-11	Piston	67° 04.46’	54°28.90’	630	304	78
NBP93-01-12	Piston	65° 05.10’	54° 48.74’	443	89	n/r
NBP93-01-13	Piston	62° 42.75’	50° 24.65’	3406	417	121.5

n/r = no recovery

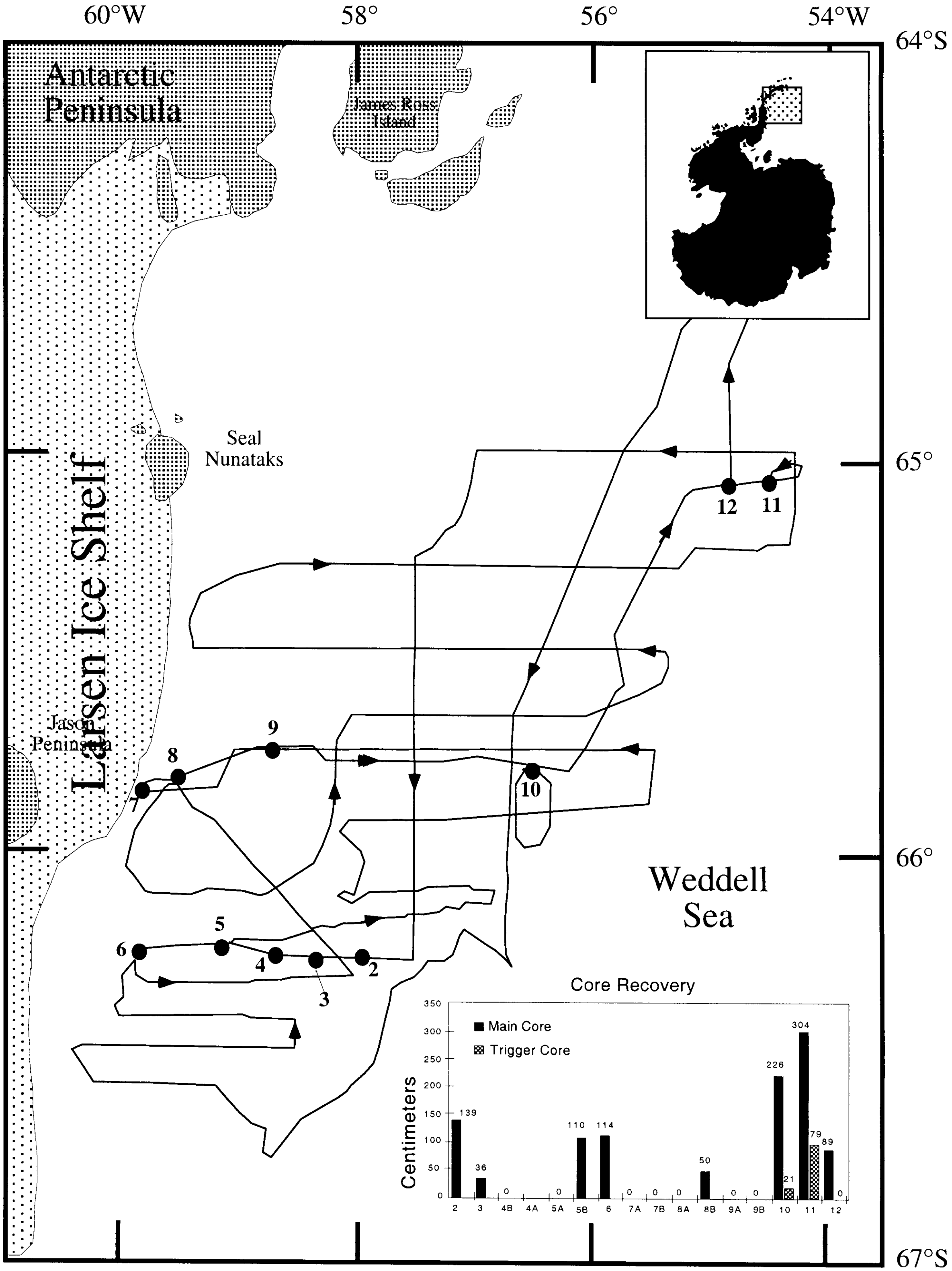


Figure 1. Map of Cruise NBP93-01 survey tracks (solid lines) and coring stations (filled circles) near the Larsen Ice Shelf. Upper right inset: Location of survey area shown in this figure. Lower right inset: graph of core recovery for the Larsen Ice Shelf cores. Map courtesy of Ben Sloan (modified).

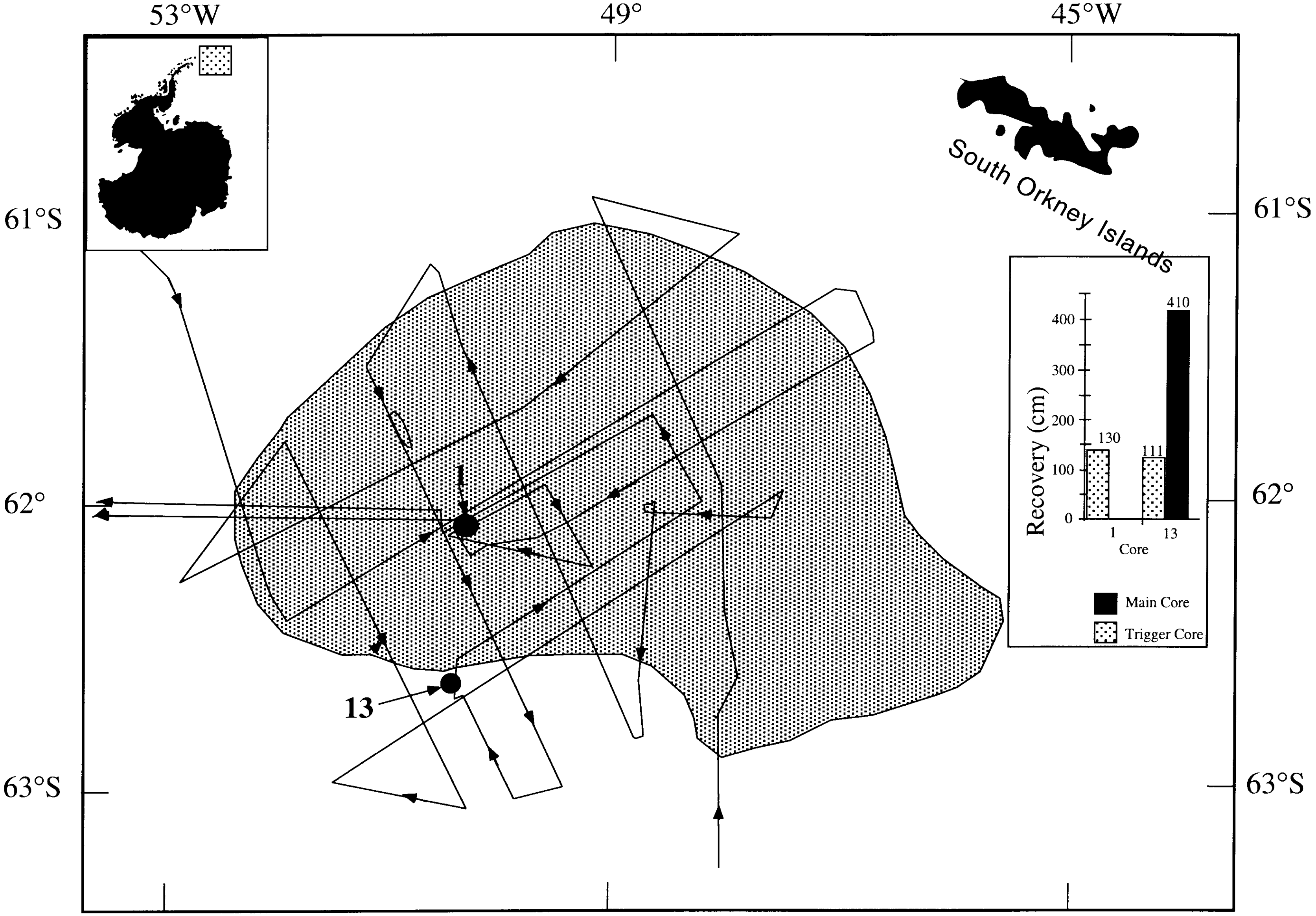


Figure 2. Map of Cruise NBP93-01 tracklines (solid lines) and coring stations (filled circles) in the region of the Powell Basin (shaded area). Upper left inset: Location of survey shown in this figure. Middle left inset: Graph of core recovery for the Powell Basin region. Map courtesy of Ben Sloan (modified).

CORE PROCESSING

At the Antarctic Research Facility all cores are cut using an adjustable, track-operated, radial power saw (Cassidy and Devore, 1973). The saw is adjusted to cut only through the thickness of the plastic core liner. Cuts are made on opposite sides of the core liner. Once the liner is cut, the core sediments are split by drawing a wire through the middle of the core. Each half section of core is cleaned of plastic debris (which results from cutting the liners) by scraping the sediment perpendicular to the core axis with a stainless steel spatula. Core halves are then measured, labeled every 20 cm (taking into account any bagged sediments), and heat-sealed within polyethylene sleeving to prevent desiccation. Disturbance of the sediment structures resulting from flow-in or sediment washing are recorded immediately after the core is opened.

All cores are stored in a refrigerated store room (~2°C) at the Antarctic Research Facility. Bagged samples are placed in labeled plastic bags and are also kept in refrigerated storage.

CORE DESCRIPTION PROCEDURES

General Description Procedures

Procedures used for describing the cores listed in this volume are, in general, similar to those used in previous studies published by the Antarctic Research Facility (e.g., Kaharoeddin et al., 1988; Bryan, 1992a, b). These procedures are presented below.

The description of each core consists of three types of information:

1. The primary information (latitude, longitude, water depth, core length);
2. The lithologic description (using megascopic and smear-slide observations);
3. Information concerning core conditions that are not inherent to the lithologic character of the sediments (disturbance, missing section, etc.).

Most of the primary information is obtained from the deck-log, or from other information provided by the chief scientist(s) of the cruise. Core conditions not inherent to the lithologic character of the sediments are recorded from the deck log and from initial observations after cutting the core liner.

Each core description is accompanied by a graphic log illustrating the main lithologic boundaries, inclusions, sedimentary structures, and disturbances of the sedimentary units. The same criteria and format used for describing piston cores are used for describing trigger and gravity cores. The positions of the core section breaks are also indicated on the log in order to inform the investigator as to where samples should not be taken, since the cutting of cores into sections may result in sediment disturbance. Not all information appearing in the written portion of the lithologic description is illustrated in the graphic log. Note that a different scale was used for core NBP93-01 13PC (600 cm/page instead of 300 cm/page).

In addition to the recovery of piston, trigger, and gravity cores, a variety of bagged sediments are normally collected during most cruises. Bagged samples are listed following the graphic core descriptions and are also available for sampling (Note: no bagged sediments were collected for cruise NBP93-01). Bagged sediments include:

1. Sediments representing the total recovery of sediment by the coring attempt (gravity, piston, and trigger cores).

2. Sediments recovered by grab-sampling.

3. Sediment that has come out of the core liner. Most bagged sediments in this category are from core catchers/cutters and the top or bottom of core sections. The bag samples from the core sections usually result from difficult extrusion of the core liner from the core barrel, or from the accidental spilling of sediment from the liner end either during handling or cutting of the liner into shorter sections while at sea.

Megascopic Examination and Description

The elements of description of each unit are presented in the following order:

1. The upper and lower boundaries of the unit in centimeters. (For bagged sediments, this interval is replaced by the wet weight of the sediment in grams). Lithologic units are recognized on the basis of compositional, textural, and other sedimentological characteristics.

2. Name and Munsell color and color code of the sediment. Gradual changes in texture or color of the unit are described accordingly. The term "graded" can be applied to the name of the unit (see the following section on sediment classification). Interlayering with other types of sediment is also noted.

3. Observable distribution of volcanic ash, manganese nodules, and staining.

4. Internal structures within the unit: zone, layer, lamina, lense, stringer.

5. Inclusions: Sedimentary clasts, pebbles, lapilli, manganese nodules.

6. Bioturbation.

7. Disturbances due to the coring operation and/or transportation.

8. Nature of the bottom contact of the unit.

Other than coarse volcaniclastics, most of the cores consist of muddy lithologies, and classification is based on smear-slide observations. Sediments larger than 63 µm in size must usually be avoided in smear slide preparations. In the case of sediments with mixed sizes (> and < 63 µm), an estimate of coarse -vs- fine fraction is necessary for sediment classification. If there is an obvious coarse fraction within an otherwise muddy lithology, a small portion of the sediment is wet-sieved (63 µm sieve) and observed under the binocular microscope. A rough visual estimate is then made of the amount of coarse -vs- fine sediment (based on the amount sieved -vs- residual coarse sediment >63 µm). For example, if a smear slide is a diatomaceous mud, but approximately half of the original lithology is sand, the sediment will be a sandy diatomaceous mud. Thus, estimated values of dominant constituents from smear slide analyses, wet-sieving, and megascopic examination are used in classification.

Glacial marine sediments generally consist of mixed-size classes (such as pebbles in mud). However, no attempt was made to utilize a separate classification for these sediments. Instead, the matrix is classified according to the guidelines outlined herein for fine-grained sediments, and clasts are described separately as inclusions within the lithology.

The size class and sorting of a sand or pebble unit are usually mentioned in the description. Size classes of sand-size fractions were determined by use of the AMSTRAT (American/ Canadian Stratigraphic) size-class comparison card. On this card, each of the five size classes (very coarse, coarse, medium, fine, very fine) of sand-size particles has been divided into two subclasses (very coarse-upper, very coarse lower; coarse-upper, coarse lower; etc.). The ten subclasses (separated by 0.5 phi intervals) are graphically depicted on the card for comparison with the sediment. Determination of the mean grain size of sand is a matter of matching the size of the most abundant grains to one of the five size classes exhibited on the card.

A unit may exhibit several colors, and color changes within a unit are described as being gradational or sharp (abrupt). Mottling refers to irregular spots of differing color within the sediment, and the color of mottling may be included in the description. The color of the sediment is determined by visual comparison of fresh sediment with the Munsell color chart. If the color of a sediment cannot be matched exactly with the color chart, the closest color is used.

Any variation in the abundance of a major component in a unit, observable either megascopically or through smear-slide analyses, is given in the description. Minor constituents that are scattered within a unit (micro-manganese nodules, lapilli, ash, etc.) may also be identified on smear slides. Their abundance is determined after a thorough examination of the core and described as scattered, common, or abundant. Manganese and ferrous oxides that occur as staining materials can be either in the form of small patches, or spread uniformly within a certain interval. These stainings are described by the terms slightly, moderately, or highly stained.

In describing the internal structures within a sedimentary unit, the stratigraphic position of each structure is noted, and when applicable, the composition and the color are also described. Each structure is defined as follows: *Zones* are defined as small intervals (less than 20 cm) in which a notable change in the abundance of some components or inclusions in the unit can be detected, either through megascopic examination or in the smear slide analysis. *Layers* have a thickness of between 1 to 10 cm and are separated from the main unit by a discrete change in lithology and distinct planes of contact. Layers less than 5 cm thick are usually not included on the graphic lithology column of the core description form but denoted by a symbol in the structure column. *Laminae* are similar to layers, but have a thickness of less than 1 cm. *Stringers* are laminae which are discontinuous and often irregular in form. In the description of a unit, the following sequence is used: zones, layers, laminae, and stringers.

Inclusions within an unit are described in the following order:

1. *Sedimentary clasts* are described in detail including size, composition, color, and position in the core (Example: "sedimentary clasts up to 12 mm composed of calcareous, ash-bearing mud, diatomaceous mud, and muddy diatomaceous ooze, all olive gray (5Y 4/1), common throughout").

2. *Manganese nodules* are described as to their size and position in the core.

3. *Volcaniclastics* are described as to their textural class and position in the core. Sometimes the rock type (pumice, scoria) is also mentioned.

4. *Pebbles* are described as to their size, roundness, and position in the core (Example: "very fine to fine, subangular to subrounded pebbles common throughout"). Occasionally, their rock type is also given. Coatings, encrustations, and cementation by manganese or ferrous oxides are common on clastics and volcaniclastics; they are mentioned when present.

Bioturbated sediments are described in terms of slightly, moderately, or highly bioturbated. The qualifiers can be approximated as follows:

Slightly:	less than 5% bioturbation
Moderately:	between 5% to 30% bioturbation
Highly:	30% or more bioturbation

Operational disturbances are disturbances in the sediment usually occurring during the coring operation, transportation, and occasionally during the splitting of the core, resulting in total or partial loss of the primary sedimentary structures and the stratigraphic integrity of the sediment. The degree of the disturbance is described in terms of slightly, moderately, or highly disturbed. *Slightly disturbed* sediments still retain most of their primary sedimentary structures, particularly along the central axis of the core. *Moderately disturbed* sediments have lost almost half of their original structures and must be sampled carefully if they are to be stratigraphically meaningful. *Highly disturbed* sediments have lost most or all of their primary structures; it is not recommended that these be sampled for stratigraphic study because of mixing of sediment components. Highly mixed sediment that has randomly entered the core by suction during the coring operation is described as *flow-in* and is usually characterized by vertical striations that can be traced from the base of the core.

Water entrapped in the liner can wash sediment along the side of the liner during transport. Sediments disturbed in this manner are described as *slightly or moderately washed along the side*, and can still be sampled carefully for stratigraphic work. The term, "highly washed along the side", is not used because such sediment is almost always highly disturbed. An uncommon disturbance occurs when the overlying sediment is dragged along the side of the liner. Cores described in this manner can be sampled (carefully) for stratigraphic work.

Smear Slide Analysis

Smear slides are routinely made from regular intervals throughout the core during the description process. Slides are made from each macroscopically visible lithologic unit in the core (as recognized by compositional, textural, and color changes), but if the core is homogeneous in composition (e.g., a diatomaceous ooze), only one or two slides may be made for the entire core.

Smear slides are made as follows: Using a toothpick, a small amount of sediment is obtained from the core. This sample is mixed with a drop of distilled water on a standard 1" x 3" glass slide until the sediment and water are smeared into a very thin film. The slide is then dried on a hot plate (using low temperature). When the slurry is dry, 1 to 3 drops of Norland Optical Adhesive (NOA 61) are put over the dried sediment film and covered with a glass cover slip. The slide is then placed under an ultraviolet lamp for 2 or 3 minutes to cure the adhesive. After curing, the slide is then ready for viewing under a petrographic microscope. Using transmitted light and phase contrast, biogenic sediment components and heavy minerals are readily visible. Polarized light is used to view most clastic components.

For each smear slide, the percentage abundance of the following constituents are estimated using the percentage composition chart of Shvetsov (Terry and Chilingar, 1955) and reported on the core description logs:

1. Minerals: quartz, feldspar, mica, heavy minerals, volcanic glass, glauconite, pyrite, and micromanganese nodules.

2. Biogenic constituents: foraminifera, calcareous nannofossils, unspecified carbonate, diatoms, radiolarians, sponge spicules, silicoflagellates, ebridians, and ostracodes.

On the basis of the dominant sedimentary constituents, the sediment is classified according to the guidelines outlined below. On the core description form a symbol “D” by the smear slide percentage denotes the dominant lithology, a symbol “m” denotes a minor lithology, zone, layer, laminae, or stringer, and “TR” denotes trace quantity.

SEDIMENT CLASSIFICATION

The system of sediment classification used in this volume modified from Kaharoeddin et al. (1988). This classification is based on abundance estimates of constituent particles (from smear slide observations) and megascopic examination.

The three major groups of sediment are (Figure 3):

I. Pelagic sediments, consisting of pelagic clay, siliceous ooze, calcareous ooze, or mixtures of siliceous and calcareous ooze;

II. Transitional sediments consisting of mixtures of biogenic and clastic sediments; and

III. Terrigenous and volcanic detrital sediments.

Pelagic Sediments

Pelagic Clay

This type of sediment accumulates at a very slow rate and generally has a brown hue. Authigenic components are common (5% or more in estimated abundance), however, they may be present only in small quantities and distributed in such a manner that they are not found on the smear slide. Usually, a careful examination of the core, aided by the smear slide analysis, is necessary to determine whether or not a sediment is a pelagic clay. The primary components of pelagic clay are clay minerals and silt-size quartz particles, and the clay may contain less than 30% biogenic components. A qualifier cannot be added to pelagic clay; hence, pelagic clay containing 25% diatoms is not called diatomaceous pelagic clay.

Pelagic Biogenic Sediments

Included in this group are sediments containing at least 30% biogenic skeletons, but containing less than 30% silt and clay. They are named according to their principle fossil types: diatomaceous ooze, radiolarian ooze, siliceous ooze, foraminiferal ooze, nannofossil ooze, or calcareous ooze. A second (lesser) biogenic component may be used as a qualifier if more than 15%. The following rules apply for naming pelagic biogenic sediments:

1. If both the principal and lesser fossil types are similar in their chemical composition (i.e., calcareous or siliceous), the sediment may be called a siliceous ooze or calcareous ooze, depending on its chemical composition.

2. Calcareous sediment that has unspecified carbonate more than one-third of the total carbonate is called calcareous ooze.

3. If the principal and lesser fossil types differ in chemical composition, then both components are used in the sediment name, joined by a hyphen (e.g., diatomaceous-foraminiferal ooze).

Transitional Biogenic Sediments

Included in this group are sediments containing at least 30% silt and clay. Two subdivisions are recognized: the transitional siliceous sediments having at least 15% diatoms but less than 30% calcareous skeletons, and transitional calcareous sediments having at least 30% calcareous skeletons. The following rules apply for naming transitional biogenic sediments:

1. A transitional siliceous sediment is called muddy diatomaceous ooze if diatoms are more abundant than silt and clay; otherwise, it is called diatomaceous mud.

2. The transitional calcareous sediments are named according to their principal fossil types: marly foraminiferal ooze or marly nannofossil ooze. If the lesser biogenic component exceeds 15%, the sediment is called marly calcareous ooze.

Terrigenous and Volcanic Detrital Sediments

Terrigenous Detrital Sediments

Sediments in this group are classified according to their texture as defined by the standard size classes of sediment according to Friedman and Sanders (1978; Figures 4 and 5). Sand/silt/clay ratios, based upon optical examination of smear slides, are presented in Table 2 at the end of the core-log description section. These ratios are used to assist in classification of terrigenous sediments. The following rules apply for sediments that are primarily composed of mixtures of sand, silt and clay:

1. The sediments are named after their major clastic component (end-member) if that component is greater than or equal to 70% (i.e., sand, silt, clay).

2. Sediments containing a mixture of silt and clay greater than or equal to 70% are called mud.

3. Sediments containing between 30% and 50% sand are named: sandy silt if the silt content is between 50% and 70%; sandy clay if the clay content is between 50% and 70%, or sandy mud if the mud content is less than 70%.

4. Sediments containing between 50% and 70% sand and between 30% and 50% mud are called muddy sand.

5. Sediments containing a minor component between 15% and 30% (e.g., diatoms or pebbles) should have a qualifier (e.g., diatomaceous muddy sand).

Pebbles are seldom encountered as a distinct sedimentary unit in marine sediments except in glacial marine sediments. The following rules apply to the naming of sediments that consist primarily of pebbles:

1. Sediments containing 70% or more pebbles are called pebbles.

2. Sediments containing between 50% and 70% pebbles and between 30% and 50% either mud or sand are called muddy pebbles or sandy pebbles, respectively.

Pebble units often contain finer matrix sediment, some or nearly all of which may be washed away during core retrieval or transportation. Removal of matrix sediment by washing is usually easily identified during core description. If the matrix sediment constitutes more than 10% of a pebble unit, the composition of the matrix is mentioned.

In graded sequences in which the size of the particles ranges from one textural class to another (e.g., silt to sand), the term *graded clastics* is used as the name of the unit. If the size of the particles ranges within one textural class, the unit is named according to its textural class (e.g., "sand, yellow gray (5Y 7/2), graded").

Volcaniclastics

This sediment group is classified according to the classification proposed by Fisher (1961, 1966). The nomenclature and the size limits are as follows:

Fine ash: less than 63 µm
Coarse ash: 63 µm to 2 mm
Lapilli: 2 mm to 64 mm

As suggested by Fisher (1966), the term "volcanic" is not used as an adjective of ash or lapilli. The term "volcaniclastic" is used only for graded sequences where the particles size grades from ash to lapilli; thus, the name of the unit is graded volcaniclastics. In the case of graded sequences where the size of the particles ranges within one textural class, the unit is named according to its textural class (e.g., "coarse ash, brownish black (5YR 2/1) graded, well sorted").

Volcaniclastics that have biogenic or terrigenous components in excess of 15% will have a qualifier with the term "bearing" added to the qualifier (e.g., "diatom-bearing coarse ash"). The same term is also added to the qualifier of other groups of sediment if the unit contains more than 15% volcaniclastics (e.g., "ash-bearing diatomaceous ooze").

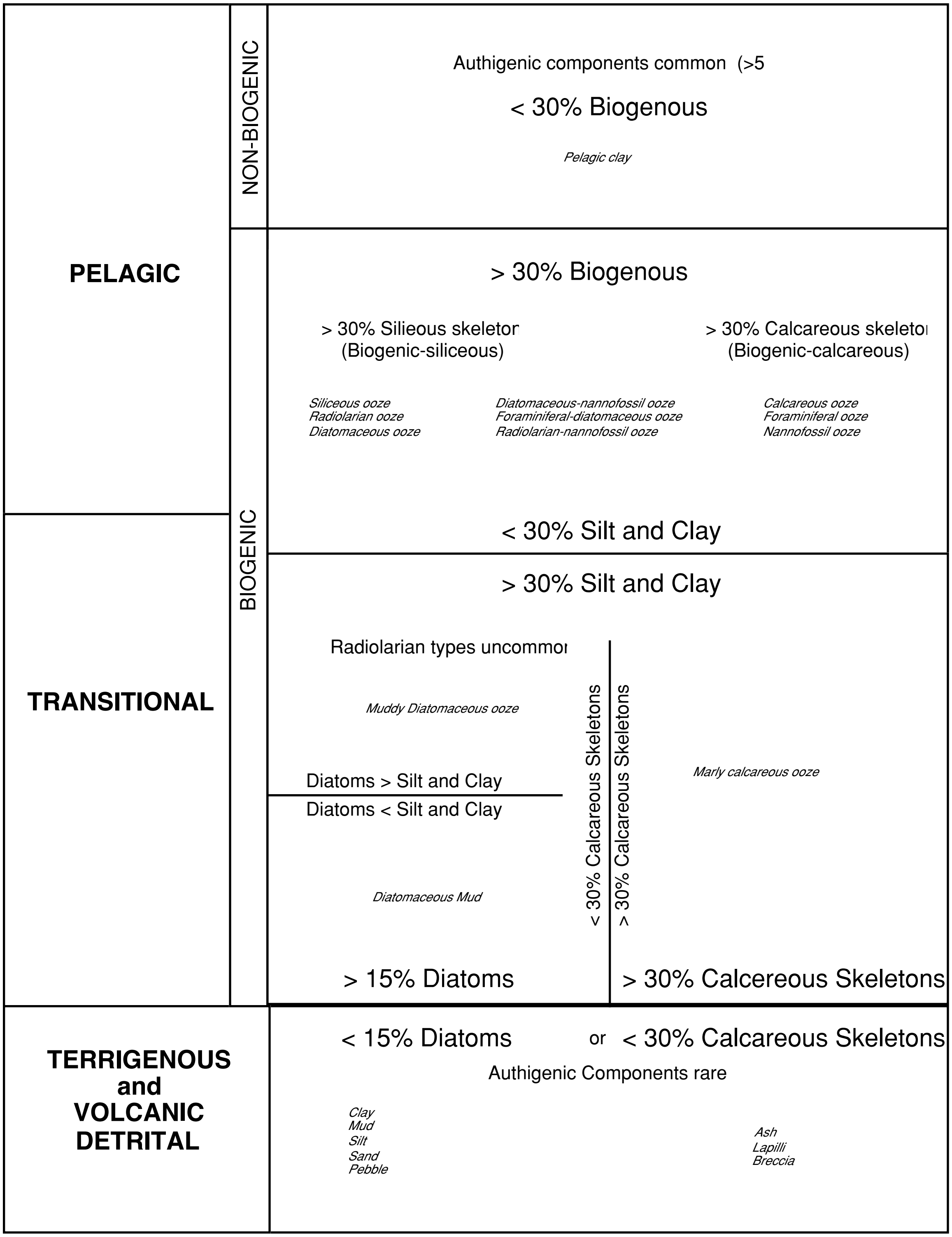


Figure 3. Classification scheme used for marine sediments.

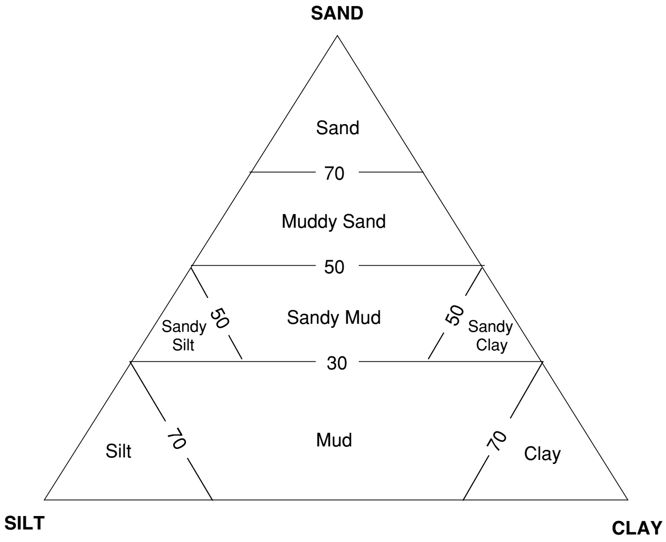
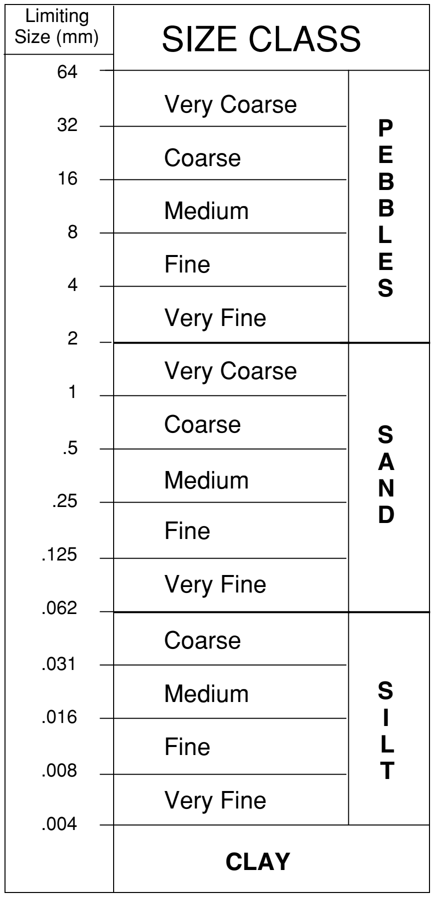


Figure 4. Classification of clastic sediments

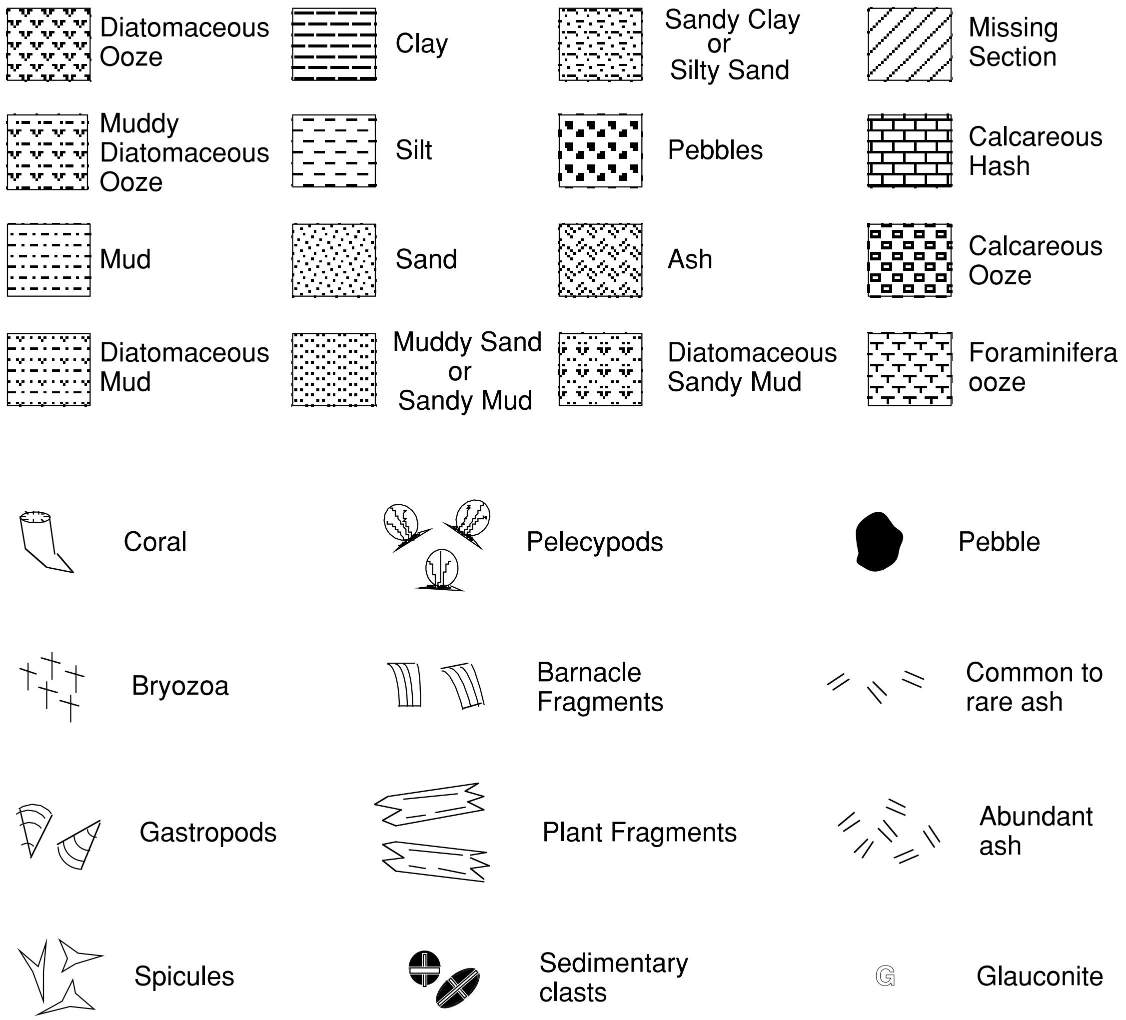


Standard size classes of sediment
(modified after Friedman and Sanders, 1978)

Figure 5. Standard size classes of sediments.

SEDIMENT CORE DESCRIPTIONS
R/V *Nathaniel B. Palmer, Cruise 1, 1993*

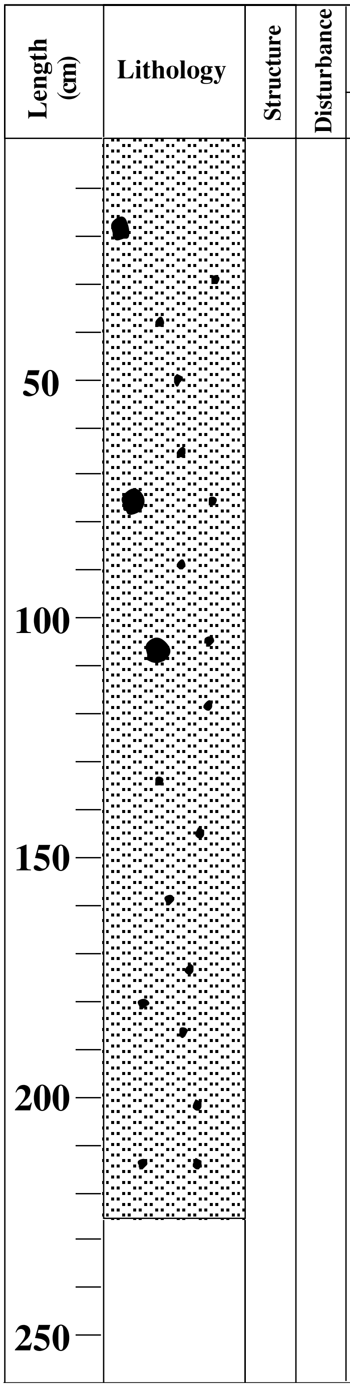
Graphic Lithology Key



Graphic Structures Key

Piston Cores

NBP93-01-10 PC



Latitude:	**65° 46.19' S**	**Water Depth:**	**330 m**
Longitude:	**56° 28.44' W**	**Core Length:**	**226 cm**

LITHOLOGIC DESCRIPTION

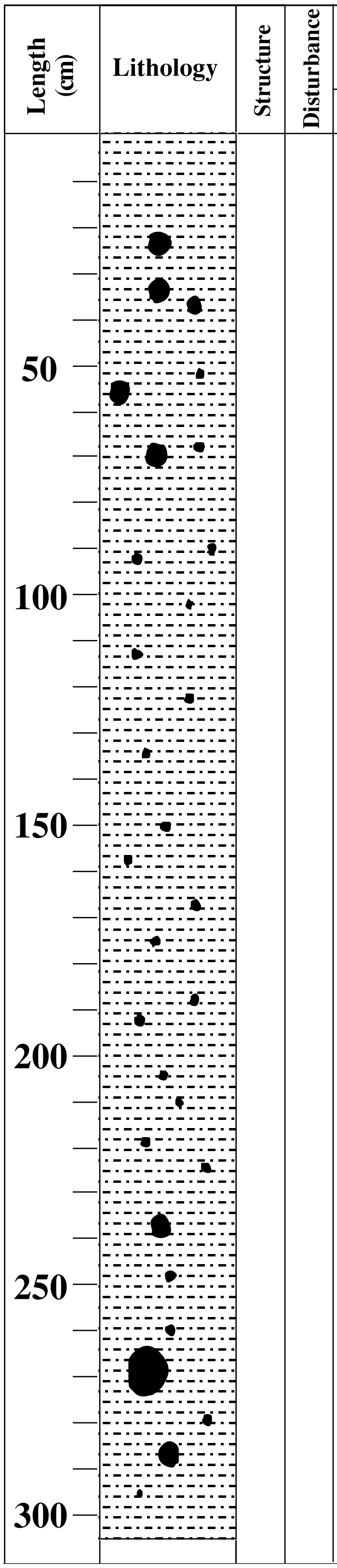
0-226: The core consists of olive gray (5Y 4/2) sandy mud. Very coarse, angular, basaltic pebbles are found at 18-19, 73-78, and 104-107 cm. Very fine to fine, angular, basaltic pebbles are scattered thoughout the interval from 20-226 cm. No pebbles are evident in a more indurated zone from 0-20 cm.

The core is cut at 76 cm.

Smear Slides:

Minerals:	4 cm (D)
Diatoms	TR
Clay	50
Quartz	47
Heavy minerals	3
Hornblende	TR
Glauconite	TR

NBP93-01-11 PC



Latitude:	**67° 04.46' S**	**Water Depth:**	**630 m**
Longitude:	**54° 28.90' W**	**Core Length:**	**304 cm**

LITHOLOGIC DESCRIPTION

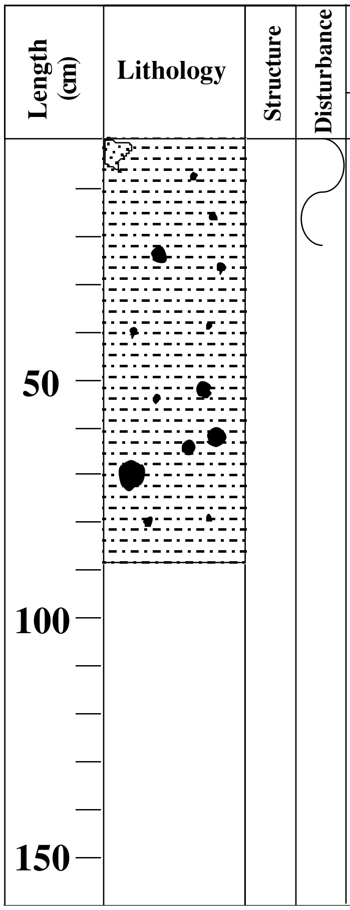
0-300 cm: The core consists of homogeneous, olive gray (5Y 4/2) mud. Coarse, subrounded, basaltic pebbles are found at 24-26, 33-36, 37-38, 54-57, 70-71, 237-239, 265-271, and 285-287 cm. A very coarse pebble is located in the sample half of the core from 265-271 cm. Many very fine to fine, subrounded, basaltic pebbles are scattered thoughout the core from 3-300 cm.

The core is cut at 150 cm.

Smear Slides:

Minerals:	2 cm (D)	100 cm (D)
Spicules	TR	--
Clay	64	50
Quartz	35	47
Heavy minerals	1	3

NBP93-01-12 PC



Latitude:	**65° 05.10' S**	**Water Depth:**	**443 m**
Longitude:	**54° 48.74' W**	**Core Length:**	**89 cm**

LITHOLOGIC DESCRIPTION

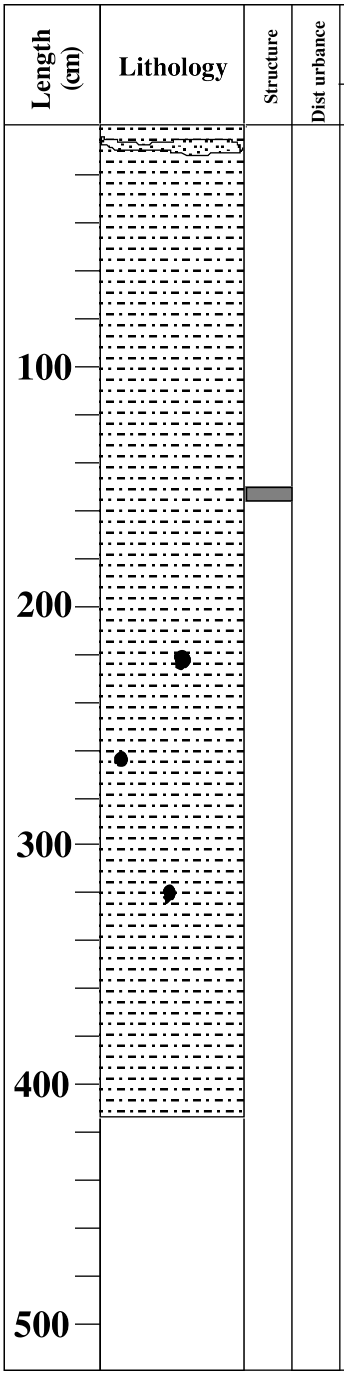
0-89 cm: The core is homogeneous, olive gray (5Y 4/2) mud grading downward into dark gray (5Y 4/1) mud at the base. The core is slightly disturbed by washing along the core liner from 0-20 cm. A bleb of well-sorted, rounded, fine sand is present at 0-5 cm. Coarse, subrounded, basaltic pebbles occur at 24-25, 51-52, 61-62, 63-64, and 69-73 cm. Many very fine to fine, subrounded, basaltic pebbles are scattered throughout the core.

The core is cut at 13 cm.

Smear Slides:

Minerals:	4 cm (m) (bleb)	4 cm (D)
Diatoms	--	TR
Clay	29	62
Quartz	70	35
Heavy minerals	1	3
Glauconite	--	TR

NBP93-01-13 PC



Latitude:	**62° 42.75' S**	**Water Depth:**	**3406 m**
Longitude:	**50° 24.65' W**	**Core Length:**	**417 cm**

LITHOLOGIC DESCRIPTION

0-417 cm: The core consists of bioturbated mud grading in color from olive gray (5Y 2/2) at the top to dark gray (5Y 4/1) at the base. An irregular layer of rounded, fine sand occurs from 6-10 cm. A dark grayish brown (2.5Y 4/2) clay-rich layer of indurated sediment ocurrs at 148.5-149.5 cm. Medium, subrounded, basaltic pebbles are located at 223-223.5, 262-264, and 315-316 cm. Black (5YR 2.5/1) manganese-oxide staining occurs over the intervals from 0-118, 180-264, 315-316, 326-328 340-344, and 359-362 cm. Black (5YR 2.5/1) mottling is found in a zone from 137-180 cm, with the mottling more concentrated in intervals from 140-147, 151-159 and 175-179 cm.

The core is cut at 118 and 268 cm.

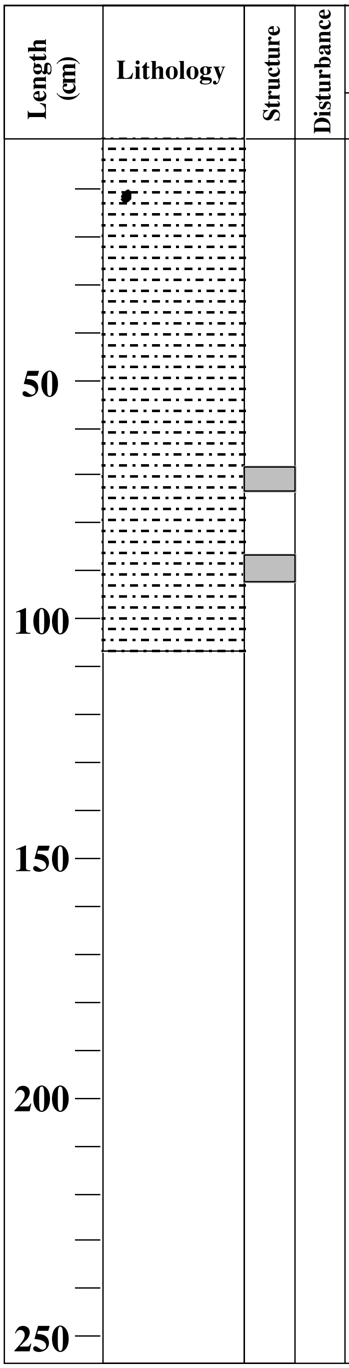
Smear Slides:

Minerals:	2 cm (D)	8 cm (m)
Diatoms	TR	--
Spicules	TR	TR
Clay	69	20
Quartz	30	79
Heavy minerals	1	1
Glauconite	--	TR
Hornblende	TR	TR
Feldspar	--	TR

Minerals:	149 cm (m)	410 cm (D)
Diatoms	--	TR
Clay	80	64
Quartz	20	35
Heavy minerals	--	1
Hornblende	--	TR
Mica	TR	--

Trigger Cores

NBP93-01-01 TC



Latitude:	**62° 10.00' S**	**Water Depth:**	**337 m**
Longitude:	**50° 20.00' W**	**Core Length:**	**108 cm**

LITHOLOGIC DESCRIPTION

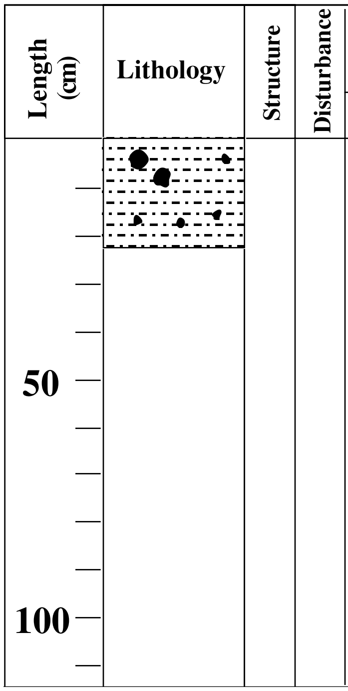
0-108 cm: The core consists of highly bioturbated olive gray (5Y 4/2) mud. The sand fraction is greater towards the top of the core. A fine, angular, basaltic pebble is found at 12-13 cm. Dark brown (7.5YR 3/2) mottling occurs in a zone from 17-41 cm with the heaviest concentration from 16-34 cm. Black manganese oxide staining occurs in a zone from 41-108 cm. A dark gray (5Y 4/1) more clay-rich layer occurs from 68-71 cm, and a dark gray (5Y 4/1) more sand-rich layer is located at 87-89 cm.

Smear Slides:

Minerals:	2 cm (D)	69 cm (m)
Diatoms	TR	TR
Radiolarians	--	TR
Spicules	TR	TR
Clay	54	69
Quartz	45	30
Heavy minerals	1	1
Glauconite	TR	TR
Hornblende	TR	TR

Minerals:	88 cm (m)	105 cm (D)
Diatoms	--	–
Radiolarians	--	–
Spicules	--	TR
Clay	40	59
Quartz	59	40
Heavy minerals	1	1
Glauconite	--	TR
Hornblende	TR	–

NBP93-01-10 TC



Latitude: **65° 46.19' S**
Longitude: **56° 28.94' W**

Water Depth: **330 m**
Core Length: **21 cm**

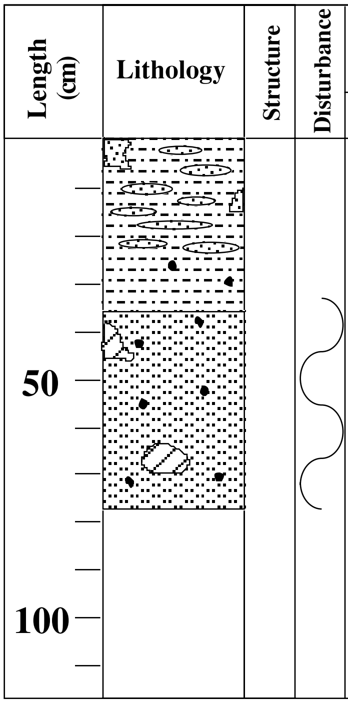
LITHOLOGIC DESCRIPTION

0-21 cm: The core consists of homogeneous, dark gray (5Y 4/1) mud. Coarse, angular, basaltic pebbles are found at 7-8.5 and 9.5-11.5 cm. Subrounded, very fine, basaltic granules are scattered thoughout the core. No structure is evident in the core.

Smear Slides:

Minerals:	3 cm (D)
Diatoms	TR
Feldspar	TR
Clay	64
Quartz	35
Heavy minerals	1

NBP93-01-11 TC



Latitude: **65° 04.46' S**
Longitude: **54° 28.90' W**

Water Depth: **630 m**
Core Length: **78 cm**

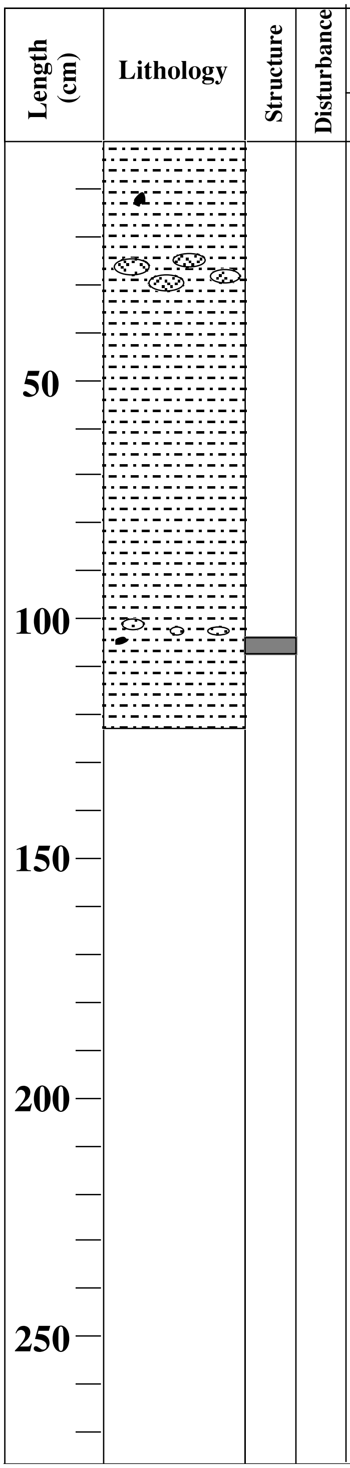
LITHOLOGIC DESCRIPTION

0-78 cm: The core consists olive gray (5Y 4/2) mud at the top of the core that grades downcore into a very dark gray (5Y 3/1) sandy mud. Subrounded, very fine, basaltic granules are scattered thoughout the core. Many small lenses of subrounded, poorly-sorted, fine sand occur in the interval from 0-23 cm. Two vugs are present in the core; one at 38-44 cm and another at 55-60 cm.

Smear Slides:

Minerals:	3 cm (m)	10 cm (D)
Diatoms	--	TR
Feldspar	TR	--
Clay	15	62
Quartz	85	35
Heavy minerals	--	3

NBP93-01-13 TC



Latitude:	**62° 42.75' S**	**Water Depth:**	**3406 m**
Longitude:	**50° 24. 65' W**	**Core Length:**	**121.5 cm**

LITHOLOGIC DESCRIPTION

0-121.5 cm: The core consists of olive gray (5Y 4/2), well-bioturbated mud/clay. Medium, subangular, basaltic pebbles are found at 13-14 cm and at 104-105.5 cm. Dark brown (7.5 YR 3/2) mottling is found in a zone from 0-60 cm, with the heaviest mottling occuring over the interval from 19-26 cm. Small blebs of fine volcanic glass occur at 26-29 cm and small blebs of well sorted, very fine sand occur at 102-103 cm. A layer of more sand-rich mud is found from 104-106 cm. Black manganese-oxide staining occurs throughout the interval from 35-121.5 cm.

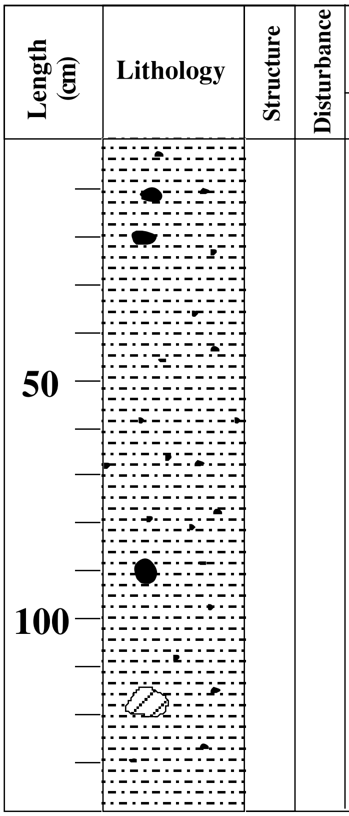
Smear Slides:

Minerals:	2 cm (D)	29 cm (m)	60 cm (D)
Spicules	TR	TR	TR
Diatoms	TR	TR	TR
Feldspar	--	--	--
Clay	60	20	88
Quartz	36	3	0
Heavy minerals	1	1	1
Glauconite	TR	--	TR
Hornblende	--	--	TR
Mica	--	--	1
Volcanic glass	--	76	--

Minerals:	103 cm (m)	104 cm (m)
Spicules	TR	TR
Diatoms	TR	TR
Feldspar	TR	--
Clay	25	68
Quartz	74	30
Heavy minerals	1	1
Glauconite	TR	TR
Hornblende	TR	--
Mica	TR	1
Volcanic glass	--	--

Gravity Cores

NBP93-01-02 GC



Latitude:	**66° 14.18' S**	**Water Depth:**	**332 m**
Longitude:	**57° 57.44' W**	**Core Length:**	**139 cm**

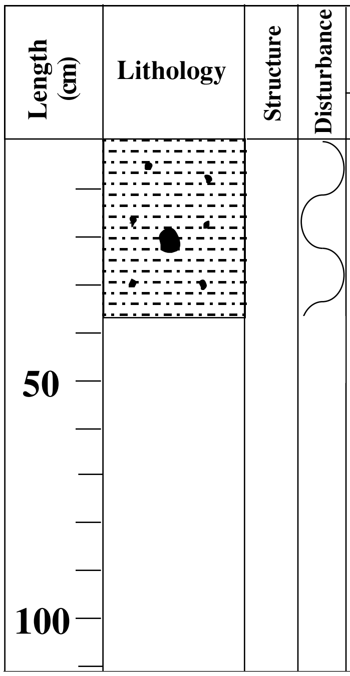
LITHOLOGIC DESCRIPTION

0-139 cm: The core consists of homogeneous, dark olive gray (5Y 3/2) mud/clay. Subrounded, coarse, basaltic pebbles occur at 11-14, 19-21, and 90-92 cm. Very fine basaltic pebbles are scattered thoughout the core. A small vug is present from 115-120 cm.

Smear Slides:

Minerals:	5 cm (D)	125 cm (D)
Diatoms	TR	TR
Spicules	TR	TR
Clay	72	67
Quartz	25	30
Heavy minerals	3	3
Feldspar	--	TR
Hornblende	TR	TR
Glauconite	--	TR

NBP93-01-3 GC



Latitude:	**66° 13.94' S**	**Water Depth:**	**339 m**
Longitude:	**58° 14.42' W**	**Core Length:**	**36 cm**

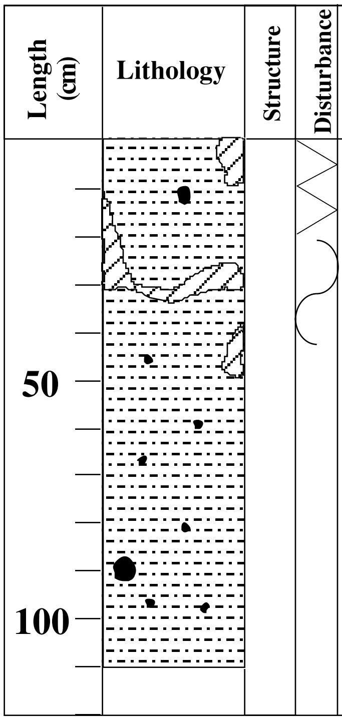
LITHOLOGIC DESCRIPTION

0-36 cm: The core consists of homogeneous, dark olive gray (5Y 3/2) mud/clay. A coarse, subrounded, basaltic pebble is found at 20-21 cm. Subrounded, fine sand and subrounded, fine, basaltic pebbles are scattered thoughout the core. The core is slightly disturbed by washing along the core liner.

Smear Slides:

Minerals:	5 cm (D)	30 cm (D)
Diatoms	TR	TR
Spicules	TR	TR
Clay	72	67
Quartz	25	33
Heavy minerals	3	3
Glauconite	--	TR

NBP93-01-05 GC



Latitude:	**66° 12.27' S**	**Water Depth:**	**338 m**
Longitude:	**59° 09.81' W**	**Core Length:**	**110 cm**

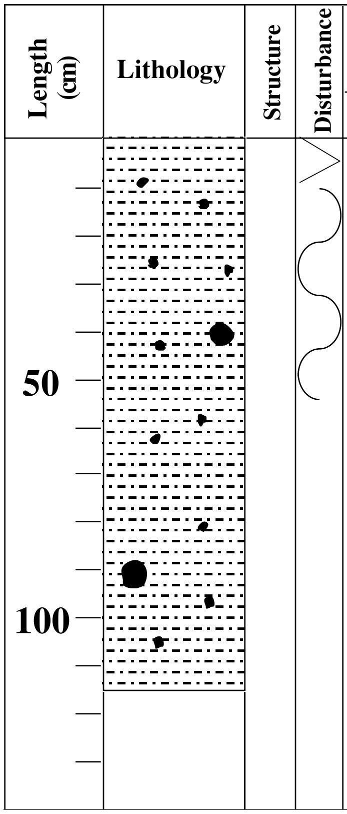
LITHOLOGIC DESCRIPTION

0-110 cm: The core consists of olive gray (5Y 3/2) mud from 0-48 cm and grades into dark olive gray (5Y 4/2) mud from 48-110 cm. The core is moderately disturbed from 0-29 cm and slightly disturbed from 36-40 cm. Three irregular vugs are present at 0-12, 19-30, and 35-39 cm. Coarse, subrounded, basaltic pebbles occur at 9-12 and 89-91 cm. Many, angular, very fine, basaltic pebbles are scattered throughout the interval from 48-110 cm.

Smear Slides:

Minerals:	5 cm (D)	50 cm (D)	105 cm (D)
Diatoms	TR	TR	TR
Spicules	TR	TR	TR
Clay	62	52	62
Quartz	35	45	35
Hvy Min	3	3	3
Hornblende	TR	TR	TR
Glauconite	--	TR	TR

NBP93-01-06 GC



Latitude:	**66° 13.24' S**	**Water Depth:**	**349 m**
Longitude:	**59° 51.78' W**	**Core Length:**	**114 cm**

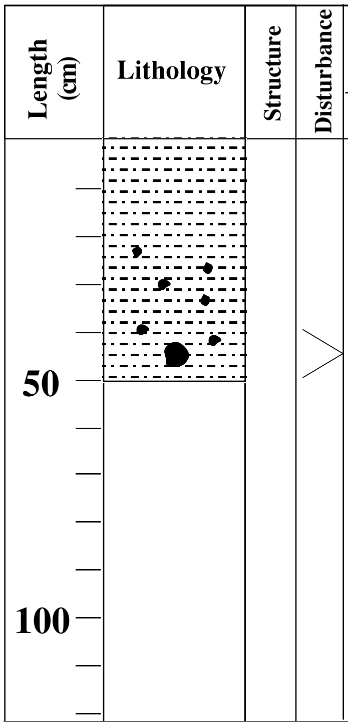
LITHOLOGIC DESCRIPTION

0-114 cm: The core consists of homogeneous mud that is dark gray (5Y 4/1) in the upper 25 cm and very dark gray (5Y 3/1) from 25-114 cm. The upper half of the core is sandier than the lower half. The core is moderately washed from 0-11 cm, slightly washed from 11-25 cm, and slightly washed from 62-68 cm. Oxidized organic material occurs at 8-9 cm. Medium, subrounded, basaltic pebbles are found at 37-38 and 90-91 cm. Angular, very fine, basaltic pebbles are scattered thoughout the interval from 25-114 cm.

Smear Slides:

Minerals:	10 cm (D)	30 cm (D)	110 cm (D)
Diatoms	TR	TR	TR
Clay	65	77	70
Quartz	30	20	25
Heavy minerals	3	3	4
Feldspar	1	--	TR
Hornblende	TR	TR	TR
Glauconite	TR	TR	--
Mica	1	--	1

NBP93-01-08 GC



Latitude:	**65° 44.11' S**	**Water Depth:**	**339 m**
Longitude:	**58° 47.53' W**	**Core Length:**	**50 cm**

LITHOLOGIC DESCRIPTION

0-50 cm: The core consists of homogeneous, olive gray (5Y 4/2) mud. The core is slightly disturbed from 40-43 cm and moderately disturbed from 43-50 cm. The base of the core is heavily indurated. Very fine to fine, angular, basaltic pebbles are present over the interval from 23-50 cm. A coarse, subrounded, basaltic pebble is found at 45-46 cm, and oxidized organic material is present from 44-45 cm.

Smear Slides:

Minerals:	8 cm (D)
Diatoms	TR
Spicules	TR
Clay	59
Quartz	40
Heavy minerals	1

Table 2. Sand/silt/clay ratios estimated from smear slides

Core ID	Interval (cm)	Sand	Silt	Clay
NBP93-01-02 GC	5	10	20	70
NBP93-01-02 GC	125	20	10	70
NBP93-01-03 GC	5	5	20	75
NBP93-01-03 GC	30	3	22	75
NBP93-01-05 GC	5	10	25	65
NBP93-01-05 GC	45	5	15	80
NBP93-01-05 GC	50	10	35	55
NBP93-01-05 GC	105	5	30	65
NBP93-01-06 GC	10	20	5	75
NBP93-01-06 GC	30	15	5	80
NBP93-01-06 GC	110	10	15	75
NBP93-01-08 GC	8	15	25	60
NBP93-01-10 PC	4	30	30	40
NBP93-01-11 PC	2	15	20	65
NBP93-01-11 PC	100	10	40	50
NBP93-01-12 PC	4	65	5	30
NBP93-01-12 PC	5	5	30	65
NBP93-01-13 PC	2	5	25	70
NBP93-01-13 PC	8	75	5	20
NBP93-01-13 PC	149	10	10	80
NBP93-01-13 PC	410	5	30	65
NBP93-01-01 TC	2	25	20	55
NBP93-01-01 TC	69	10	20	70
NBP93-01-01 TC	88	20	40	40
NBP93-01-01 TC	100	5	35	60
NBP93-01-10 TC	3	5	30	65
NBP93-01-11 TC	3	80	5	15
NBP93-01-11 TC	10	10	25	65
NBP93-01-13 TC	2	10	30	60
NBP93-01-13 TC	29	75	10	15
NBP93-01-13 TC	60	TR	20	80
NBP93-01-13 TC	103	70	5	25
NBP93-01-13 TC	104	20	10	70

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Dry Valley Drilling Project (DVDP)
Eastern Taylor Valley (ETV) Project
Cenozoic Investigations of the western Ross Sea (CIROS 1&2)
Ross Ice Shelf Project
R/V *Polar Duke* Expeditions (cruises 86, 88, 89, 90, 91, 92)
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