Handbook for Shipboard Paleontologists

Ocean Drilling Program
Texas A&M University
Technical Note No. 12

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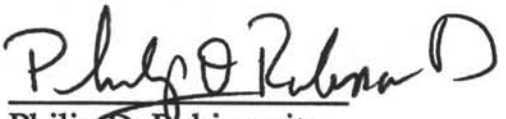

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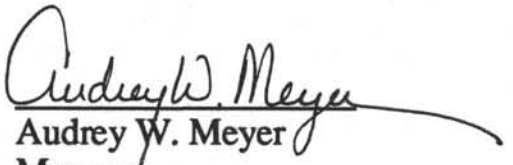

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HANDBOOK FOR SHIPBOARD PALEONTOLOGISTS

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INTRODUCTION

Shipboard paleontologists are responsible for making biostratigraphic age determinations of sediments and sedimentary rocks recovered during cruise operations aboard *JOIDES Resolution*. They also make a general environmental interpretation based on paleontological evidence, within the primary constraint of time available.

With input from the international paleontological community, the Ocean Drilling Program (ODP) has attempted to provide the equipment and resources necessary for shipboard paleontologists to make their vital contribution to the cruise scientific results. The facilities and procedures used on board the drill ship are summarized in this handbook.

The handbook is divided into four chapters and six appendixes. Chapter 1 describes the responsibilities of shipboard paleontologists. Chapter 2 outlines shipboard procedures for core handling, sampling for paleontological studies, data recording, and report writing. Chapter 3 discusses the shipboard paleontological laboratory and optical equipment, with directions for proper use. Chapter 4 introduces the resources of the DSDP and ODP paleontological databases available both aboard ship and ashore.

The appendixes contain lists of paleontology reference books, Zeiss microscope manuals, and biostratigraphically important microfossil species. The two types of sample request forms and information on DSDP/ODP paleontology databases are also appended.

CHAPTER 1
DUTIES AND RESPONSIBILITIES OF SHIPBOARD PALEONTOLOGISTS

The primary responsibility of shipboard paleontologists is to provide accurate biostratigraphic age information for sediments and sedimentary rocks in cores, and a general environmental interpretation based on paleontological evidence. The paleontologists collaborate with shipboard paleomagnetists in determining sedimentation rates at each site. All shipboard scientists also pursue their own scientific interests and assist with other scientific and curatorial activities.

This guide presents a brief introduction to shipboard facilities and procedures. Most shipboard scientists find that the transit to the first site is the best time to become familiar with the ship and its routines. Mini-classes are held to familiarize scientists with such subjects as core handling and sampling procedures, core photography, microscope use, and the data handling, word-processing, and graphics capabilities of the computer system. This is also the time to become acquainted with paleo-prep lab and microscope lab equipment. The Staff Scientist, Laboratory Officer, and Operations Superintendent can provide information and instruction regarding terms, forms, procedures and routines beyond the scope of this handbook.

Each cruise has its own specific staffing needs for specialists in particular microfossil groups, which in turn have an effect on the work schedule adopted by the paleontological group. Typically, at the outset of the cruise the Co-Chief Scientists divide the paleontologists into two teams, each working opposite 12-hour shifts. An attempt is made to balance the teams with respect to specialties and experience levels represented. A "chief paleontologist" is usually designated for each site; this responsibility rotates among group members during the cruise. The chief paleontologist coordinates work at that site, which includes writing the "Biostratigraphy" and "Sedimentation Rates" chapters and compiling illustrations for the Hole Summaries.

The paleontological team also compiles material for the "Explanatory Notes" chapter of the Hole Summaries; ideally this should be completed before drilling the first site, and given in final form to the Staff Scientist before the end of the cruise. A discussion of biostratigraphic zonations, complete with a table of stratigraphic events, estimated age and references, taxonomic schemes (where appropriate to document), preparation techniques, microscope procedures, preservation/abundance criteria, etc., should be included for each fossil group studied on the cruise. Complete references in correct ODP format must be provided. ODP format is specified in the "Instructions for Contributors to the *Proceedings of the Ocean Drilling Program*" booklet distributed aboard ship.

CHAPTER 2
SHIPBOARD PROCEDURES

CORE HANDLING AND SAMPLING

Core Deck Routine

After being cut and brought from beneath the seafloor to the drilling platform, the core and its protective core liner are removed from the outer core barrel on the rig floor and carried to the catwalk outside the core laboratory (Fig. 1). The ~9.5-m core liner containing the cored material is set on brackets attached to the catwalk railing. The liner's exterior is wiped clean, marked, and cut into 1.5-m sections starting from the top of the recovered material. The last section may be shorter than 1.5 m, depending on the total length of recovered material. Each core section is capped with a blue endcap at the top and a clear endcap at the bottom, using acetone to seal the caps to the liner. Material in the core catcher of the outer core barrel is put in a short section of core liner, capped, and placed below the last core section. A small amount of core-catcher material is removed immediately and taken to the paleontology lab for age dating. Please note that no interval within the core-catcher section is recorded for this paleontology sample, nor is it logged into the shipboard sample database.

Figure 1. Marine technicians carry core from rig floor to catwalk outside the lab stack's core entry lab.

Whole-round samples are removed from some core sections for interstitial water, organic geochemistry, and physical properties studies according to a routine sampling program established by the JOIDES Information Handling Panel, and also as part of specific sample requests. The shipboard biostratigraphers or Co-Chief Scientists may decide to relocate routine whole-round samples to different intervals, based on preliminary identification of potentially important stratigraphic information at the routine location. If shipboard study shows that an important interval or boundary has been recovered within a whole-round section, the entire whole-round sample must be returned to the Curatorial Representative for normal core processing (or special processing as a critical interval, e.g., a Cretaceous/Tertiary contact). Consequently, whole-round samples from the core must be maintained intact until after the core-catcher sample has been dated. Yellow endcaps are used to indicate where a whole-round sample has been removed (usually at the bottom of a section); otherwise, clear endcaps are used at the bottom of sections.

The core sections are carried into the core entry lab and placed on a storage rack. Each section is labeled permanently with its identification number: leg number, site number, hole letter, core number and type (H = advanced hydraulic piston core, X = extended core barrel, R = rotary core barrel, etc.), and section number. For example, the second section of the tenth (rotary-cored) core from Hole 723A, drilled on Leg 117, is labeled "117-723A-10R-2"; the core-catcher section from that core is labeled "117-723A-10R, CC."

Age Information Display

Information on drilling progress, including sub-bottom depths, recovery, and age is displayed both on a white board in the core entry lab and on television monitors throughout the lab stack. The ODP Operations Superintendent and SEDCO Coring Technician provide drilling information. Paleontologists are responsible for updating age information upon examination of core-catcher samples, keeping both the white board and the video display up to date. At the outset of the cruise the Computer Systems Manager will demonstrate the procedure for updating the video display using the PALEO program.

Core Lab Procedures

After a core is permanently labeled and its data entered into the computer database ("CORELOG") by Marine Technicians, it can be accessed for study, first by shipboard scientists who require whole-round core sections, rather than split core sections, for their analyses. The first analyses conducted on core sections usually include physical properties measurements (e.g., bulk density [GRAPE], sonic velocity, and thermal conductivity) and paleomagnetics measurements (e.g., magnetic susceptibility), as well as other measurements that may be required to fulfill the scientific objectives of the leg. In the case of thermal conductivity measurements, core sections must equilibrate to room temperature before measurements are taken, causing a delay in processing of about 4 hours.

After the completion of whole-core analyses, the core sections are carried into the core splitting room where they are halved lengthwise with rotary saws or wire "cheese-cutters" by Marine Technicians. One half of the split core (the "working half") is taken to the sampling table, where the Curatorial Representative oversees the collection of samples for shipboard and shore-based scientists. The other half of the split core (the "archive half") is taken to the description table for the shipboard sedimentologists or petrologists to describe.

Core Sampling

1. *Paleontological Samples*

Shipboard paleontologists normally deal with two categories of samples during the cruise: routine core-catcher samples are shared by all members of the paleontological team, and are not counted as part of any scientist's personal sampling program; personal samples are taken according to individual scientists' approved sample requests and are subject to ODP sampling limits and guidelines.

Most shipboard paleontological studies are conducted using the routine core-catcher samples. However, paleontologists often find it necessary to examine additional material within cores when trying to determine the precise position of a zonal boundary or hiatus, as time allows. For this purpose they may request that samples of a third type, shipboard paleo samples (sample code PALE), be taken as needed; Co-Chief approval is required. These samples are recorded in the sample database but are not counted against any individual's total. Splits of the residues must be returned to the Curatorial Representative before the cruise ends. Scientists may find time to process some of their personal samples during the cruise, but typically the bulk of these wait for post-cruise attention.

2. *Sample Requests*

Paleontologists begin their participation in the shipboard sampling program by submitting a Cruise Sample Request form (Appendix 1) 2 months pre-cruise. Although shipboard sampling is intended to provide material for shore-based studies destined to be published in the cruise "Scientific Results" volume, one of the primary goals of core curation is to conserve core material. Careful planning and sample selection will help meet both objectives. In order to reduce the amount of sample material removed from cores during the cruise, thus preserving the maximum amount, paleontologists are encouraged to view their shipboard sampling program as a pilot study. Once specific intervals of interest (e.g., the Paleocene) are identified by the shipboard party, a Post-Cruise Sample Request form (Appendix 2) can be completed and given to the Curatorial Representative at the end of the cruise. Upon Co-Chief approval, required during the first year post-cruise, this request will be processed quickly and the samples shipped shortly after the cores are received at the repository.

The size and frequency of shipboard samples depend largely upon the fossil group of interest and the intention of the study. For example, high-resolution studies focused on brief stratigraphic intervals may approach the ODP limit of 50 cm^3/m (lifetime maximum for an investigator without special approval of the JOIDES Information Handling Panel), while general biostratigraphic work may require one sample per alternate section (2-3 per core) in appropriate intervals and lithologies (e.g., a paleontologist who intends to study Neogene diatoms may decline to sample calcareous or pre-Neogene intervals). Intervals missed during shipboard sampling, or in which greater stratigraphic resolution is desired (within ODP limits), can be obtained (with Co-Chief approval) through a post-cruise sample request. Typical sample volumes taken for paleontological studies aboard *JOIDES Resolution* appear below (please note that these are intended merely to serve as guidelines).

Suggested Sample Volumes

Fossil Group	Sample Volume
Nannofossils	2 cm^3
Foraminifers	10 cm^3
Radiolarians	10 cm^3

Diatoms	5 cm^3
Silicoflagellates	5 cm^3
Dinoflagellates	10 cm^3
Pollen	10 cm^3
Ostracodes	20 cm^3
Larger Benthic Foraminifers	20 cm^3

Additional information regarding sample requests appears in the "Sample Distribution Policy" booklet available from the ODP Supervisor of Curation and Repositories. Questions may be directed to the Supervisor (telephone number 409-845-8490) or to the cruise Staff Scientist.

By 1 month pre-cruise, all requests will have been reviewed by the Co-Chief Scientists, the Curator, and the Staff Scientist to identify those which exceed sampling limits or conflict with other requests. Requestors may be contacted at this time in an attempt to resolve any problem before the cruise. Remaining conflicts or problems are resolved on board the ship, during port call or the first transit. Within 24 hours after the ship's departure from port the final cruise sampling plan is transmitted to ODP Headquarters for the Curator's approval.

Subsequent changes to the Sampling Plan are possible, particularly in the event of unexpected findings. However, in such cases the Curatorial Representative must have Co-Chief and/or Staff Scientist approval (and possibly approval from the ODP Curator), and may require that a new Cruise Sample Request Form be completed.

Some scientists obtain their samples from pre-assigned intervals. Others may wish to select sample locations after inspecting the cores, marking the chosen intervals with small labeled flags available at the sampling table. A menu (or map) of sample locations, using three-letter "sample codes" to identify investigators, is produced by the Curatorial Representative during the transit to the first site, and is posted on the white board next to the sampling table.

The sampling of critical intervals (important stratigraphic boundaries such as the Cretaceous/Tertiary boundary interval; also any interval with unusually high demand) may be deferred by the Curatorial Representative until the Curator has approved a sampling plan that maximizes scientific return from the interval. While shipboard scientists have priority in obtaining samples of critical intervals, the Co-Chief Scientists may invite shore-based investigators to participate in cooperative studies of the materials.

Please note that "toothpick" samples (taken for study of nannofossils, for example) are not considered part of the cruise sample plan. Paleontologists wishing to take such samples are free to do so while the core is on the sampling table, or at a later time during the cruise by arrangement with the Curatorial Representative.

The paleontologists, along with all other shipboard scientists, assist in the sampling program. At the beginning of the cruise, the Co-Chief Scientists and Staff Scientist design a sampling schedule so that sampling duties are divided equitably among the entire scientific complement. Sampling duties include routine shifts at the core lab sampling table taking samples for shipboard scientists and shore-based investigators as outlined by the Cruise Sampling Plan. Sampling is directed by the Curatorial Representative.

3. *Sampling Procedures*

Routine ODP sampling procedures have been established with the goal of minimizing sample contamination. The Curatorial Representative will instruct shipboard scientists in these procedures at the outset of the cruise. It is the responsibility of every

participant involved in shipboard sampling to ensure that a conscientious effort is made to prevent contamination.

Paleontologists should be aware of some possible sources of contamination and how to minimize the effects. Figure 2 illustrates a sampling plug inserted into a core, with regions of highest potential contamination indicated. The split surface of the working and archive core halves may be contaminated by the wire or saw during the splitting process, or by handling on the sampling table. The outer surface of the core (in contact with the core liner) may be contaminated by younger material displaced downhole by the core liner during the coring process. These regions (each roughly a few millimeters thick) should be trimmed away before processing the sample. Other regions of the core with high contamination potential are the top 10-20 cm (or more) of each core, zones of flow-in at the base of some advanced hydraulic piston (APC) cores, the drilling paste between "biscuits" in some extended core barrel (XCB) or rotary core barrel (RCB) cores, and any other interval displaying high drilling disturbance. Information about core disturbance is recorded on the barrel sheets by the sedimentologists; it is recommended that as part of their shore-based studies paleontologists compare their personal sample inventory with the barrel sheets for evidence of disturbance (and thus contamination).

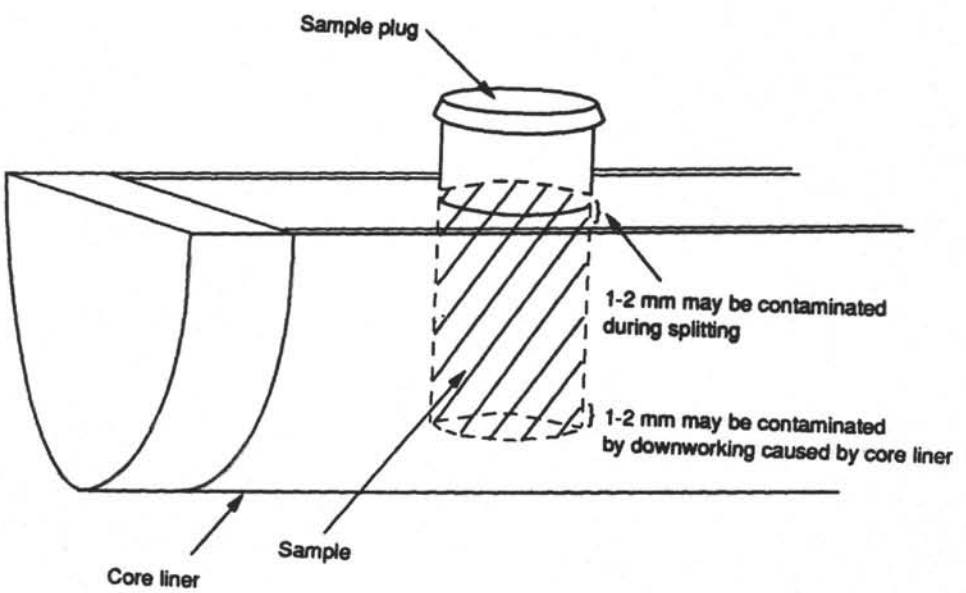


Figure 2. Drawing of a sample plug showing regions of highest potential contamination.

Another source of contamination may come from those who handle and sample the cores. In order to avoid contamination by noble metals, samplers are expected to remove all jewelry during sampling. Special precautions may be required for organic-geochemistry samples. Disposable plastic gloves and stainless steel sampling equipment are available if needed.

As noted above, most shipboard paleontological work is conducted using core-catcher samples. The core-catcher contains the deepest (and thus in most cases the oldest) material recovered at any point during drilling operations. Paleontological results from analysis of this material may be critical in making decisions regarding drilling operations. Thus it is important for the paleontologists to ensure that their core-catcher samples are selected in order to maximize the reliability of age information.

The procedures used to extract the core-catcher materials from the core-catcher assembly generally leave the material disturbed from a sedimentological point of view. However, with judicious selection of sample intervals, core catchers may provide material freer of paleontological contamination than that later available from split cores. For example, in non-soupy lithologies a relatively "clean" sample may be obtained by breaking the whole-round sample parallel to bedding and sampling the fresh fracture surface. Such material is less likely to be contaminated than that from the working halves of cores (which have been exposed to downmixing by the core barrel and liner, as well as splitting, hosing, scraping, and other handling in the core laboratory). Ideally, whenever a core arrives on deck a member of the paleontology group should go to the catwalk in order to advise the Marine Technicians in choosing the core-catcher sample.

RECORDING PALEONTOLOGICAL DATA

Paleo/Biostrat Data

The ODP Paleontology and Biostratigraphy Form (Form FM6000; Fig. 3) is provided for the use of shipboard paleontologists in recording their results. The data on these forms are made available to the public (1 year post-cruise) through the ODP Database Group, so all entries must be written legibly. BLACK BALLPOINT PEN MUST BE USED TO COMPLETE THE FORMS. This is in order to facilitate photocopying and microfilming. Sample identification information must be recorded accurately and completely on each page. Note that interval ("top" and "bottom" measured in cm) information is required for every sample except for the routine catwalk core-catcher sample. Samples obtained subsequently from the core catcher (after it is placed in a liner and split) are identified with interval measurements.

On the upper left-hand side of the form there are spaces to record the fossil group reported, abundance and preservation, and preparation methods. Lists of stratigraphically useful microfossil species are appended to this handbook as an aid in filling out these forms (Appendix 3). A form is to be completed for every sample examined, even if barren. All appropriate information must be recorded on each form.

The lower left-hand side of the form contains blanks to list the age-diagnostic taxa observed, and their relative abundances. Please be sure that these are spelled accurately and written legibly.

The right-hand side of the form contains space for interpretation of paleontological results: stage or zone, a general statement about the suggested paleoenvironment, presence of reworked fossils, and chronostratigraphic unit identified. A space for additional comments regarding the sample (and/or sketches) also appears on the form. The ODP Continuation Sheet (FM 7004) can be used for additional comments and drawings.

The information on the forms is used by the paleontologists to compile a biostratigraphic summary chart and sedimentation rate plot for each site, to write the "Biostratigraphy" and "Sedimentation Rates" chapters for the Hole Summaries, and to complete the "Biostratigraphy" column on the barrel sheets. Finally, the forms are collected by the Yeoperson and filed with the cruise prime data.

Barrel Sheets

After description of each core, the shipboard sedimentologists summarize the lithology on a Core Description Form ("barrel sheet"; Fig. 4), which is then circulated among the other scientific groups on board. The paleontologists record appropriate zonations and fossil character for each fossil group identified in the core. If more than one zone has been recognized in a core, the boundary should be shown, dashed and/or slanted if approximate. Fossil character (abundance and preservation) should be recorded either at

ODP
PALEONTOLOGY AND BIOSTRATIGRAPHY

LEG	SUB	SITE	HOLE	CORE	TYPE	SEC
120		751	A	11	H	CC

FOSSIL GROUP TREATED: Diatom

INTERVAL TOP	INTERVAL BOTTOM	DATE	OBSERVER
		4 19 88	Toshi

ABUNDANCE	Barren	Rare	Few	Common	Abundant
PRESERVATION	Poor		Moderate		Good

SAMPLE PREPARATION PROCEDURE: (Smear) Acid Sieve Other

STAGE/ZONE: N. denticuloides Zone (or N. dent. — D. dimorpha Z.)

AGE DIAGNOSTIC TAXA:	Abundance:
D. dimorpha	VA
Nitzschia denticuloides	A
D. praedimorpha	A-C
D. hustedtii	F
D. lauta s.l.	C
A. ingens	
Cosci. marginatus	
Thalassiothrix longissima	
Cosmio. insignis?	
Rhizosolenia hebetata	R

ENVIRONMENTAL INTERPRETATION:

REWORKED OLDER FOSSILS AND AGE:

RELATIVE ABUNDANCE	Trace	Few	Common

OTHER REMARKS: Tops of D. praedimorpha N. denticuloides were between 10 & 11.

?

Quat.		
Plio.	U	
	L	
Mio.	U	
	M	
	L	
Oligo.	U	
	L	
Eoc.	U	
	M	
	L	
Paleo.	U	
	L	
Cret.	U	
	L	
Jur.		
Other		

These data are to be processed into a computerized data base along with existing standardized data from other legs and will be accessible to the scientific community at large. RECORD ALL MEASUREMENTS CAREFULLY, COMPLETELY, AND LEGIBLY.

FM6000

Figure 3. Example of a completed ODP Paleontology and Biostratigraphy data form.

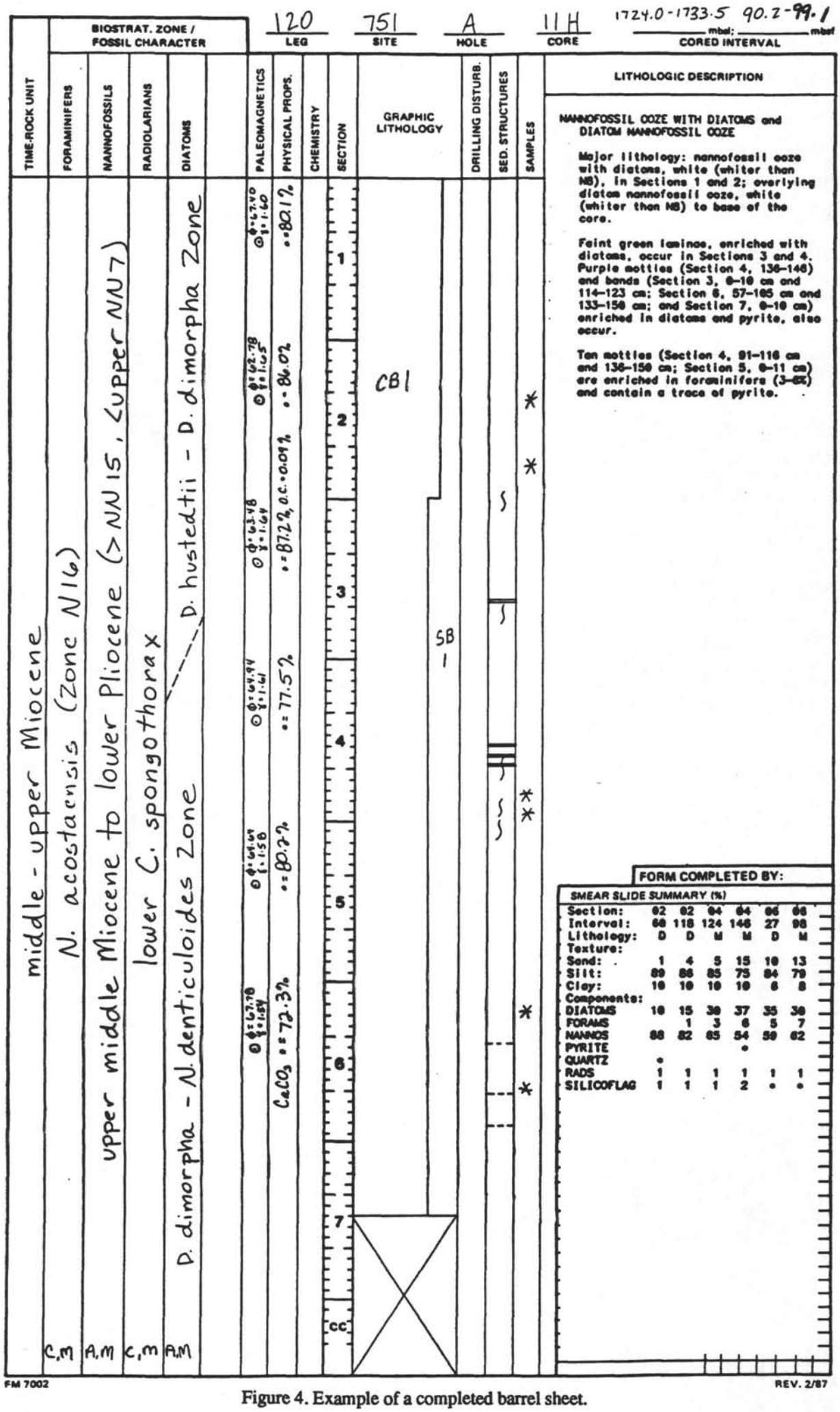


Figure 4. Example of a completed barrel sheet.

the bottom of the column (for core-catcher samples) or within the column corresponding to the sample interval position within the core. Finally, based on consensus by the group, the appropriate chronostratigraphic unit (e.g., lower Eocene, Upper Cretaceous, etc.) is indicated on the barrel sheet.

Hole Summaries

When drilling at a site has been completed, the shipboard scientists compile a site report consisting of a series of short chapters by each working group and the barrel sheets for all cores from the site. Collectively the reports from the entire leg are known as the cruise Hole Summaries; copies are distributed by ODP shortly after the cruise to all shipboard and shore-based investigators. After revision by the shipboard party during the post-cruise meeting, the Hole Summaries are published as the *Initial Reports* volume of the *Proceedings of the Ocean Drilling Program.* Additional material such as explanatory notes, underway geophysics reports, and site survey papers may also be published in this volume. Short taxonomic notes to document new species discovered on the leg may be included also.

The paleontologists' contributions to the Hole Summaries, in addition to their input on the barrel sheets, are the "Biostratigraphy" and "Sedimentation Rates" chapters. The "Biostratigraphy" chapter summarizes, for each fossil group studied at the site, zonation, environmental interpretation, and any other relevant paleontological information (e.g., preservation, abundance, diversity). The "Sedimentation Rates" chapter is a collaborative effort with the paleomagnetists and is a short summary of datums and interpretation of the accumulation rate(s) of the sedimentary section at the site.

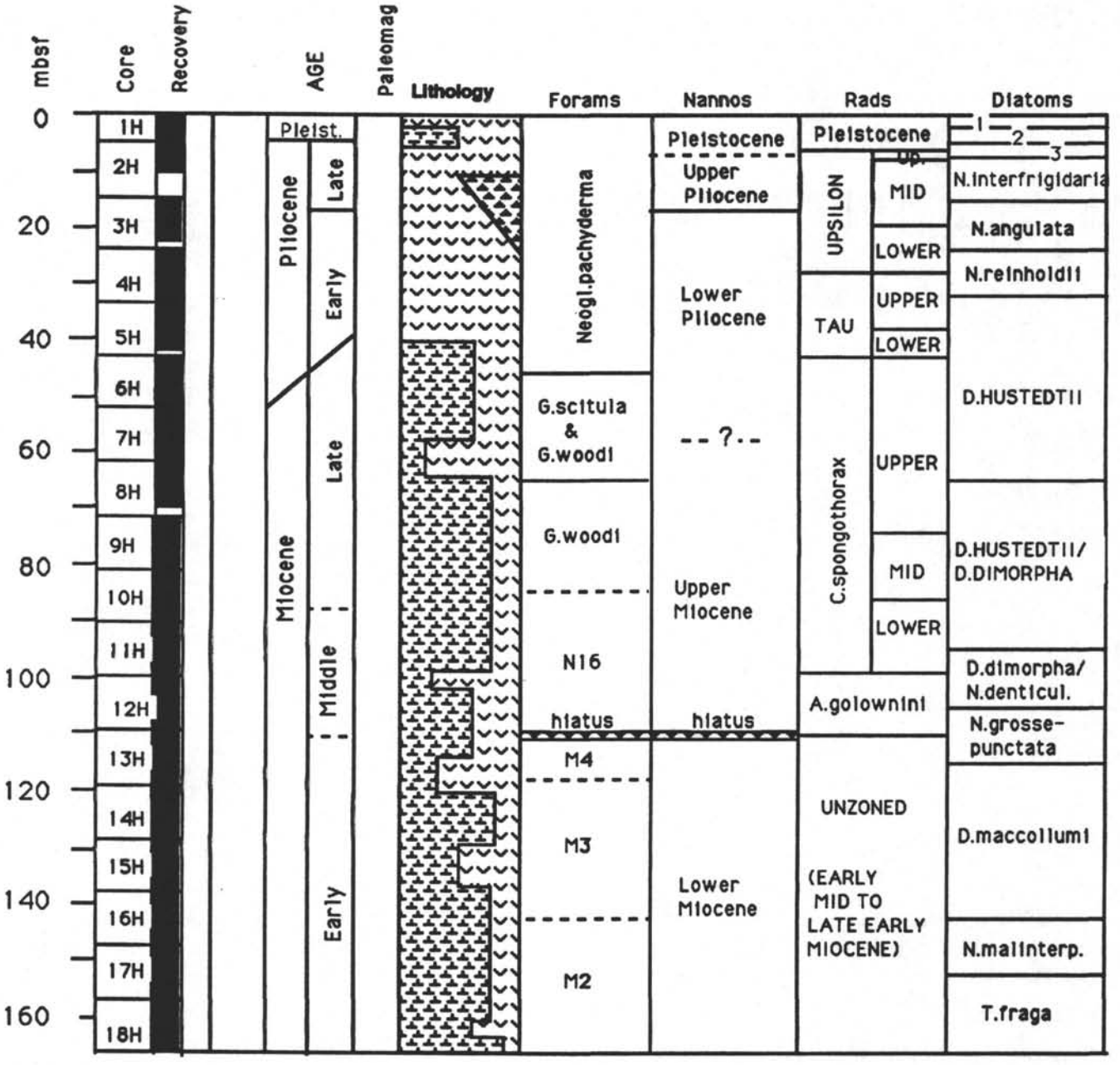
Writers of the "Biostratigraphy" and "Sedimentation Rates" chapters are advised to report all datums, ranges, zonal boundaries, etc., in terms of meters below seafloor (mbsf) rather than lithologic units (as defined by the sedimentologists). Later revision of lithologic units often causes confusion and error that may persist through publication of the cruise volume. Correlation among units defined by various shipboard groups is better presented in an easily updated diagram in a summary section of each site chapter, or in a separate summary chapter.

For each site's "Biostratigraphy" chapter, a report on each fossil group studied is written by the specialist(s) in that group, and compiled by a designated lead paleontologist who writes introductory and discussion material as appropriate. A summary biostratigraphic chart (see example in Fig. 5) should also be drawn; interaction with the other working groups is important if this age information is to appear correctly in other chapters. Be particularly careful that revisions to age information are made to every occurrence of that information in the Hole Summaries (e.g., to an "age" column in a lithologic diagram).

Range charts are optional for the "Biostratigraphy" chapter (note that the computer program Checklist II for IBM/PC is available aboard ship); likewise, comprehensive species lists or detailed synonymies are not required. References cited in the text must appear in alphabetical order and complete ODP format in the reference list. It is not necessary to include the name or date of the author of a species or subspecies in the "Biostratigraphy" chapter (e.g., "Globorotalia lenguaensis" is sufficient; "Globorotalia lenguaensis Bolli, 1957" is not required). Species names should be underlined to indicate italics. Illustrations or photographs of fossil specimens may be included as appropriate, but should be limited to those of general interest.

The "Sedimentation Rates" chapter is typically a collaborative effort between the paleontologists and paleomagnetists, any of whom may be designated lead author. A sedimentation rate diagram (see example in Fig. 6) is compiled based on biostratigraphic and paleomagnetic datums; detailed information regarding these datums should be

SITE 751 BIOSTRATIGRAPHIC SUMMARY



Key to Diatom zones: 1 - T.lentiginosa 2 - C.elliptopora/A.ingens
3 - C.vulnificus to N.interfrigidaria/C.vulnificus.

Figure 5. Example of a biostratigraphic summary chart created on a shipboard Macintosh computer by Leg 120 paleontologists.

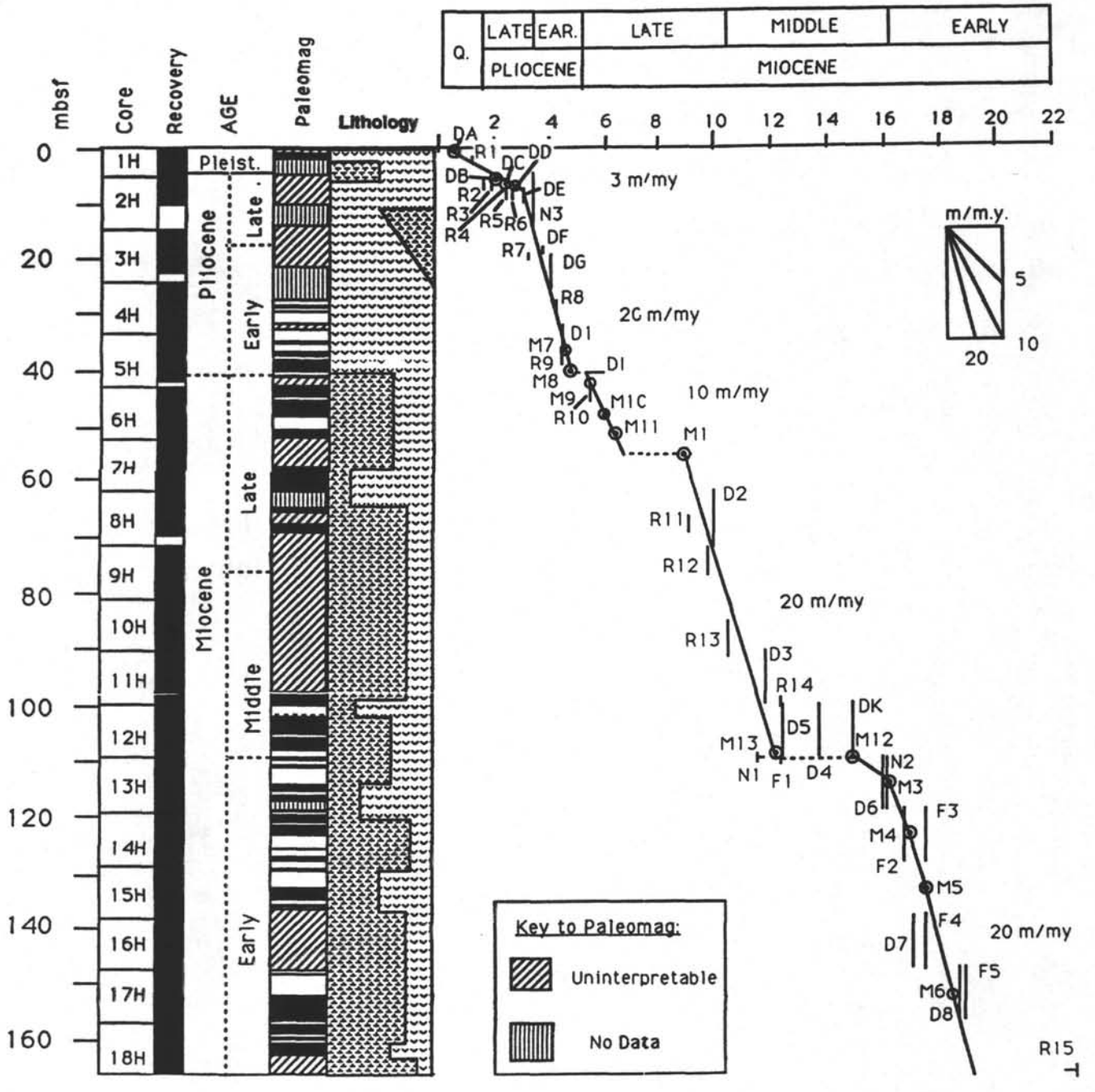


Figure 6. Example of a sedimentation rate diagram created on a shipboard Macintosh computer by Leg 120 paleontologists.

presented in an accompanying table or tables (for example see Fig. 7). The text presents an interpretation of the diagram and any appropriate additional information. Any references cited must appear in alphabetical order and complete ODP format in a reference list.

As noted previously, details regarding preparation techniques, abundance/preservation criteria, biostratigraphic zones, taxonomic schemes, etc., used to write reports should NOT be included in each chapter. Instead, a brief explanatory discussion for every fossil group studied during the cruise should be compiled (with complete references) and included in the "Explanatory Notes" chapter (see recent *Initial Reports* volumes for examples).

Core, Section, and Sample Designations

All shipboard scientists must use correct, complete designations for cores, sections, and samples:

Site Designation: Refers to the collective location of holes drilled at one beacon location.
Example: Site 747
Hole Designation: Refers to the holes actually drilled.
Example: Hole 747A
Core Designation: Leg-(site+hole letter)-(core number+core type)
Example: 120-747A-5H
Section Designation: Leg-(site+hole letter)-(core number+core type)-section number
Core Catcher Designation: Leg-(site+hole letter)-(core number+core type), CC
Examples: 120-747A-5H-1, 120-747A-5H, CC.
Sample Designation: Leg-(site+hole letter)-(core number+core type)-section number, (sample interval in centimeters)
Example: 120-747A-5H-1, 22-24 cm
The routine paleontological core-catcher sample will not have a recorded sample interval, so the correct designation is: Leg-(site+hole letter)-(core number+core type), CC.
Example: 120-747A-5H, CC

Refer to the **location of features in the core** (e.g., hiatuses, zonal boundaries) in this manner: "a hiatus must occur in the interval between Core 120-747A-5H-3, 22 cm, and -7H-1, 34 cm..." or "the C. costata/D. alata zonal boundary occurs in Core 120-747A-5H-2, 22 cm..." Note that the term "Interval" may be substituted for "Core" where appropriate.

Figure 7. Example of a datum table (Table 751-H-1)

#	Depth (mbsf)	Age (Ma)		Name
F1	109.2- 110.0	10.4	B	*N. acostaensis*
F2	118.7- 128.2	16.8	B	*G. miozea*
F3	118.7- 128.2	17.6	T	*C. dissimilis*
F4	137.7- 147.2	17.6	B	*G. zealandica*
F5	147.2- 156.7	19.0	B	*G. praescitula*
N1	109.2- 109.7	11.6	T	*R. floridana*
N2	109.2- 109.7	16.2	T	*H. ampliaperta*
N3	4.7- 14.2	3.5	T	*R. pseudoumbilica*
DA	0.83- 1.18	0.62	T	*A. ingens*
DB	5.2- 6.4	2.2	T	*C. vulnificus*
DC	6.4- 6.8	2.45	T	*C. insignis*
DD	6.8- 7.2	2.8	T	*N. interfrigidaria*
DE	7.2- 10.0	3.1	T	*N. praeinterfrigidaria*
DF	18.0- 19.2	3.8	B	*C. kolbei*
DG	19.2- 25.5	4.1	B	*N. angulata*
DI	39.8- 40.2	5.5-6.0	T	*C.i. triangularis, N. miriabilis, etc.*
DK	109.2- 118.7	15.0	B	*D. hyalina*
D1	31.6- 32.5	>4.5	T	*D. hustedtii*
D2	61.7- 71.2	10.0	T	common *D. dimorpha*
D3	90.2- 99.7	11.8	T	common *D. denticuloides*
D4	99.7- 109.2	13.8	B	common *D. hustedtii*, T *N. grossepunctata*
D5	99.7- 109.2	12.5	B	*D. dimorpha, D. praedimorpha*
D6	109.2- 118.7	16.0	B	*N. grossepunctata*
D7	137.7- 147.2	16.7	B	*D. maccollumii*
D8	147.2- 156.7	18.8	B	*N. malinterpretaria*
R1	3.5- 14.2	2.5	B	*C. davisiana*
R2	14.2- 23.7	3.2	T	*P. titan*
R3	23.7- 33.2	4.2	B	*H. vema*
R4	33.2- 42.7	4.4	T	common *L. grande*
R5	42.7- 52.5	5.4	T	*C. spongothorax*
R6	71.2- 80.7	10.1	B	*E. pseudoinflatum*
R7	80.7- 90.2	10.3	T	*A. golownini*
R8	90.2- 99.7	11	B	*C. spongothorax*
R9	109.2- 118.7	12.5	B	*A. golownini*
R10	>166.2	23	B	*C. tetrapera*
M1	54.4- 57.2	8.92	T	5
M2	69.2- 74.6	10.42	B	5
M3	114.0	16.22	T	5C
M4	123.2	16.98	B	5C
M5	132.7	17.57	T	5D
M6	152.1	18.56	T	5E
M7	36.7	4.57	T	Gilbert 'c'
M8	40.2	4.77	B	Gilbert 'c'
M9	42.6	5.35	T	3A
M10	48.5	5.89	B	3A
M11	50.6	6.37	T	Chron 6, N

CHAPTER 3
LABORATORY FACILITIES

PALEONTOLOGY PREPARATION LABORATORY

The paleontology preparation laboratory is located on the fo'c'sle deck (Fig. 8). The paleo prep lab contains equipment and supplies needed to process micropaleontological samples and make slides. Items required that do not appear on the following list should be brought to the attention of the ODP Technical and Logistics Support Office well in advance of the cruise departure date. A reasonable effort will be made to obtain such materials, or paleontologists may be advised to bring the items to the ship themselves, provided no item will constitute a hazard in the shipboard environment.

Scientists are responsible for processing their own materials. Any preparation techniques appropriate to shipboard space, safety, and time constraints may be used. Equipment and supplies for sample processing may be requested from the Marine Technicians. Technical assistance with sample preparation is normally not available.

Scientists are asked to not smoke in the microscope and paleo-prep labs because damage to microscope equipment can result. Likewise, cosmetics (e.g., mascara) that can damage microscope oculars should not be worn in the lab.

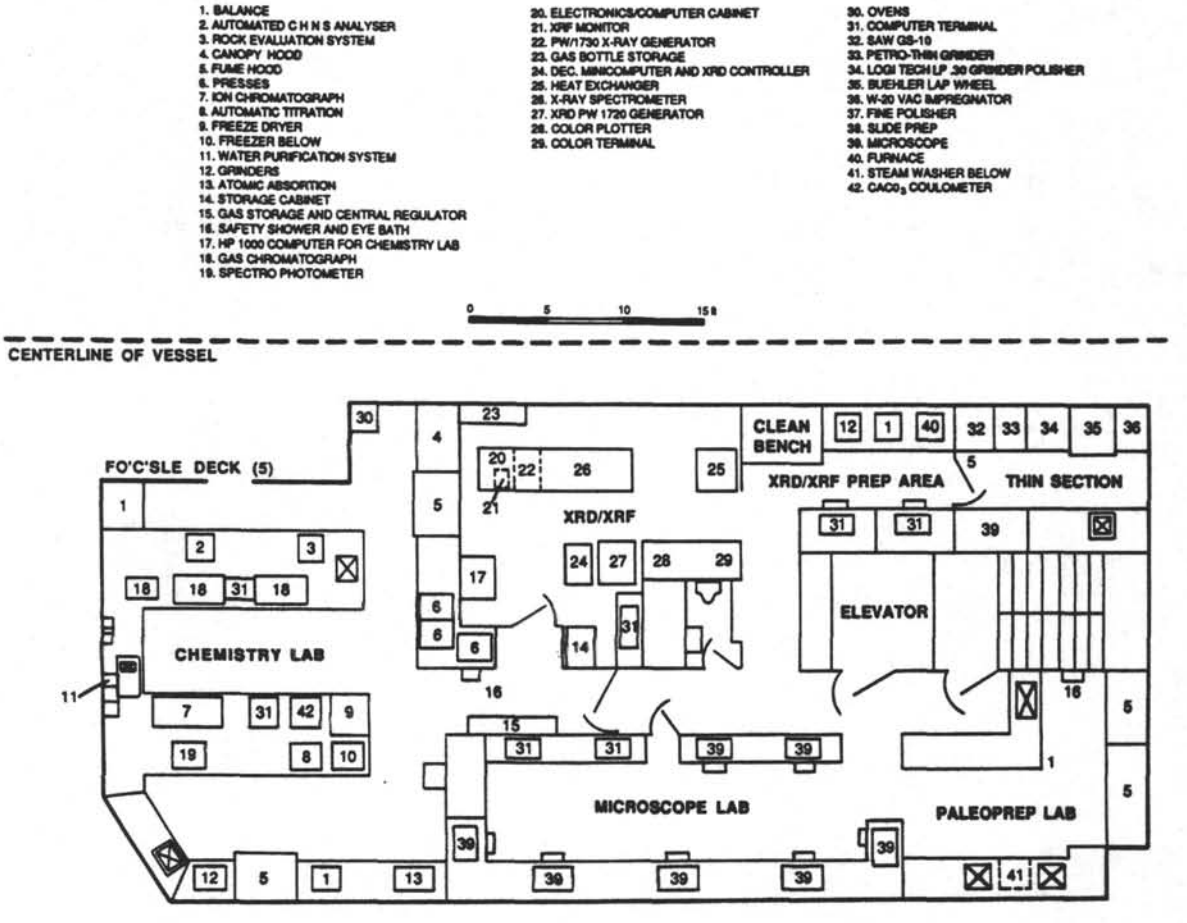


Figure 8. Layout of laboratory stack's fo'c'sle deck, including paleontology preparation (paleo-prep) lab and microscope lab.

Lab Equipment

- 2 fume hoods, HF rated (4-ft and 5-ft)
- 2 ovens
- 3 infrared lamps
- 3 hotplates
- 2 ultraviolet *light* set-ups (for curing optical adhesive)
- 2 sonic baths
- 1 sonic probe
- 2 slide warmers
- 2 benchtop fume adsorbers
- 1 lab glassware washer
- 1 sample splitter
- 1 microsplitter
- 1 centrifuge
- assortment of U.S. standard testing sieves (44-1000 μm)
- sieve cleaning brushes
- beakers, funnels, filters, evaporating dishes, etc.
- glass microslides and coverslips, cardboard micropaleo slides and metal slide holders, slide storage boxes
- slide labels, sample vials, sieve cleaning brushes, stage and eyepiece micrometers, drawing tubes for microscopes, England Finder Slides, and manual point counters
- sable hair brushes and picking trays are available from the Lab Officer

Chemicals, Mounting Media, Stains and Dyes

Below are listed some of the laboratory supplies and chemicals stocked routinely aboard ship. This is not an exhaustive listing; questions about availability of specific items should be addressed to the ODP Technical and Logistics Office. The "Reorder Level" refers to a minimum point at or before which supplies are reordered in time for the next cruise. Shipboard supplies are thus maintained at levels equal to or in excess of the "Reorder Level."

ITEM DESCRIPTION	UNIT SIZE	REORDER LEVEL
Slides, microscope, 3" x 1"	72/box	250 boxes
Slides, microscope, 75 mm x 25 mm	72/box	100 boxes
Slides, petrographic, 2" x 3"	72/box	2 boxes
Slides, petrographic, 27 mm x 46 mm	1/2 gross/box	10 boxes
Slide holders, 18-ply	100/package	5 pkgs
Slide holders, 28-ply	100/package	5 pkgs
Slide holders, 38-ply	100/package	5 pkgs
Slide mounts, 35 mm	100/package	10 pkgs
Slide mounts, single hole	100/package	3 pkgs
Slide mounts, two-hole	100/package	1 pkgs
Slide mounts, four-hole	100/package	2 pkgs
Slide mounts, ruled cavity, 1 mm deep	100/package	8 pkgs
Slide mounts, ruled cavity, 2 mm deep	100/package	15 pkgs
Slide mounts, celluloid covers, 1 mm deep	100/package	2 pkgs
Cover glass, 22 x 22 mm, #0	1 oz/box	10 boxes
Cover glass, 22 x 30 mm, #1.0	1 oz/box	25 boxes

Cover glass, 22 x 30 mm, #1.5	1 oz/box	50 boxes
Cover glass, 22 x 40 mm, #1.0	1 oz/box	50 boxes
Cover glass, 22 x 40 mm, #1.5	1 oz/box	50 boxes
Cover glass, 22 x 50 mm, #1.0	1 oz/box	50 boxes
Cover glass, 22 x 50 mm, #1.5	1 oz/box	50 boxes
Acetic acid, glacial, 99.7%	2.5-liter bottles	2 bottles
Acetone	4-liter cans	30 cans
Bromoform	500-ml bottles	2 bottles
Calgon water softener	boxes	3 boxes
Formaldehyde, 37%	4-liter bottles	1 bottle
Glycerin, white	500-ml bottles	3 bottles
Hydrochloric acid, REAGENT	2.5-liter bottles	12 bottles
Hydrofluoric acid	500-ml bottles	1 bottle
Hydrogen peroxide, 30%	500-ml bottles	160 bottles
Sodium hydroxide solution	250-ml bottles	1 bottle
Sodium pyrophosphate crystal	500-g bottles	1 bottle
Toluene	4-liter safe-tins	2 tins
Xylenes	4-liter safe-tins	4 tins
Alizarin red S stain	25-gm bottles	1 bottle
Malachite green stain	25-gm bottles	1 bottle
Methylene blue stain	25-gm bottles	1 bottle
Rose bengal stain	25-gm bottles	1 bottle
Safranin O stain	25-gm bottles	1 bottle
Thiazol yellow G (Titan) stain	50-gm bottles	1 bottle
Clove oil	100-gm bottles	1 bottle
Canada Balsam mounting medium	100-ml bottles	10 bottles
Eukitt (synthetic Canada balsam)	250-ml bottles	1 bottle
Hyrax mounting medium	1-oz bottles	8 bottles
Norland optical mounting medium	1-oz bottles	20 bottles
Permount mounting medium	100-ml bottles	3 bottles
Piccolyte mounting medium	bottles	6 bottles

MICROSCOPE LABORATORY

The microscope laboratory is for the use of paleontologists and petrologists. It is equipped with vibration-isolated Zeiss stereo and binocular microscopes and accessories. At the start of each cruise, the microscopes are set up with color-coded parts, as specified in the following list. Parts can be interchanged with other microscopes if necessary; the technician responsible for microscopes will modify the set-ups as requested. The list of additional equipment below details specific objectives, oculars, etc., that are available for use. Problems with microscopes should be referred to the Lab Officer.

There is one Zeiss Photomicroscope III, two Zeiss Standard WL microscopes, and three Zeiss stereomicroscopes intended for use by paleontologists. Also in the microscope lab are one Zeiss Photomicroscope (type III POL) and two standard Zeiss WL petrographic microscopes, with polarizing lenses and accessories for reflected light and optical figure analysis, intended for use by petrologists. All of these microscopes have interchangeable accessories compatible with other Zeiss models, and accept still photographic and video camera attachments.

Black-and-white print film is available for taking photomicrographs of interest to the shipboard scientific party as a whole; **scientists wishing to take photomicrographs for their own research must bring the necessary film supplies with them.**

Photomicrographs taken for general shipboard party use are identified on a standard form (one sheet per roll of film), and contact prints are made. No personal-research photomicrographs will be developed or printed, and no enlargements of the negatives are made aboard ship, except for inclusion in the Hole Summaries. Enlargements can be requested from the ODP Data Librarian after the end of the cruise.

Two video screen printers are available in the microscope lab: a black-and-white Mitsubishi printer and a color Hitachi printer. These printers are intended to provide "photodocumentation" of specimens more rapidly and inexpensively than possible with regular photographic techniques. Although the resulting images are not of publication quality, they are valuable for study and interpretation. The Marine Technicians can assist in setting up these systems and demonstrating their correct use.

A shipboard paleontology library is kept in the microscope lab. This collection of texts, journals, and reprints is cataloged in a separate paleontology library catalog and is cross-indexed in the main shipboard science library catalog (see Appendix 4). Although considerable effort has gone into assembling as complete a set of references as possible for biostratigraphic age determination, some important references may still be missing. In particular, paleontologists are advised to bring their own copies of reprints that are critical to their shipboard work. Efforts to expand the paleontology library holdings are ongoing, and the assistance of shipboard paleontologists in suggesting or contributing additional reference materials greatly benefits future shipboard parties. The Yeoperson can catalog, bind, and add donated materials directly to the shipboard library.

Also available is the computer program Checklist II for IBM P/C (paleontology data analysis and graphics).

SHIPBOARD OPTICAL EQUIPMENT

At the start of each cruise the microscopes are set up in "default" configurations, with components labeled according to a color-code system (as indicated in the following lists). In order to suit the particular needs of paleontologists (and petrologists), whose numbers and specialties vary from cruise to cruise, components may be exchanged between microscopes, or substitutions made from the list of additional equipment; see the Marine Technicians for assistance in making these changes.

Optical Equipment for Paleontology

Zeiss Standard WL microscope (LT GREEN)
- stand
- condenser carrier
- auxiliary lens
- fixed polarizer
- Nomarski DIC
- stage (paleontological)
- intermediate body (optivar)
- objective turret
- PH2 25X Neofluar obj. w/DIC adapter ring
- PH3 63X Neofluar obj. w/ DIC adapter ring
- PH3 63X Planapo obj. w/ DIC adapter ring
- 63X Planapo objective w/ DIC adapter ring
- 100X Planapo objective w/ DIC adapter ring
- 63X DIC slides
- trinocular tube
- KPL 10X wide oculars
- 6 volt power supply
- illuminator with power cord
- 6-12 volt power supply
- illuminator 100

Zeiss Standard WL microscope (GRAY)
- stand
- condenser carrier
- auxiliary lens
- fixed polarizer
- Nomarski DIC
- stage (paleontological)
- intermediate body (optivar)
- objective turret
- 10X Neofluar objective w/ DIC adapter ring
- PH2 16X Plan objective w/ DIC
- 25X Plan objective w/ DIC adapter ring

- PH2 40X Neofluar obj. w/ DIC adapter ring
- PH3 63X Neofluar obj. w/ DIC adapter ring
- 25X DIC slide
- 63X DIC slide
- trinocular tube
- KPL 10X wide oculars
- 6 volt power supply
- illuminator with power cord
- 6-12 volt power supply
- illuminator 100
- blue/green filter

Zeiss SR Stereomicroscope (GOLD/RED)
- stand
- body
- binocular tube
- 10X wide oculars
- standard objective
- F=50 objective
- black and white stage
- glass stage

Zeiss SR Stereomicroscope (BLUE/WHITE)
- stand w/ power supply
- body w/ light
- binocular tube
- 10X wide oculars
- standard objective
- F=50 objective
- black and white stage
- glass stage
- fiber light illuminator

Zeiss SR Stereomicroscope (LTGRN/YELLOW)
- stand
- body
- binocular tube
- 10X wide oculars
- standard objective
- F=50 objective
- black and white stage
- glass stage
- fiber light illuminator

Photomicroscope III (GOLD)
- stand
- condenser carrier
- auxiliary lens
- rotary polarizer
- Nomarski DIC
- stage (paleontological)
- intermediate body (optivar)
- rotary analyzer
- objective turret
- 40X Planapo objective w/ DIC adapter ring
- PH2 40X Neofluar obj. w/ DIC adapter ring
- PH3 63X Neofluar obj. w/ DIC adapter ring
- 63X Planapo objective w/ DIC adapter ring
- 100X Planapo objective w/ DIC adapter ring
- 63X DIC slides
- tube head
- inclined binocular tube
- KPL 10X wide oculars
- large power supply
- illuminator 100
- 35 mm film cassettes with film labels
- film label holders
- film crank
- automatic exposure remote control
- cable release
- blue filter

Optical Equipment for Petrography

Zeiss Photomicroscope III (YELLOW)
- stand
- condenser carrier
- auxiliary lens
- rotary polarizer
- condenser w/ swing-out front lens: 1.3
- stage (petrographic)
- mechanical stage
- intermediate body (petrographic)
- rotary analyzer
- objective turret
- 2.5 Plan objective
- 10X Pol objective
- 25X Neofluar objective
- 40X Pol objective
- 63X Neofluar objective
- tube head w/ photo tube
- inclined binocular tube
- KPL 10X wide oculars
- 6-12 volt power supply
- large power supply
- illuminator 100
- blue filter
- 1 lambda accessory plate
- 1/4 lambda accessory plate
- 0-3 lambda accessory plate
- epi-condenser (incident light attachment)
- 4X Epiplan objective

- 8X Epiplan objective
- 16X Epiplan objective
- 40X Epiplan objective
- polarizer with heat shield filter insert
- blue/green filter insert
- incident light tube
- 35 mm film cassettes with film labels
- film label holders
- film crank
- automatic exposure remote control
- cable release

Zeiss Standard WL Microscope (WHITE)
- stand
- condenser carrier
- auxiliary lens
- rotary polarizer
- condenser w/ swing-out front lens: 0.9
- stage (petrographic)
- mechanical stage
- intermediate body (petrographic)
- rotary analyzer
- objective turret
- 2.5X Plan objective
- 10X Pol objective
- 25X Neofluar objective
- 40X Pol objective
- 63X Neofluar objective
- binocular tube
- KPL 10X wide objectives
- 6 volt power supply
- illuminator w/ power cord
- blue filter
- 1 lambda accessory plate
- 1/4 lambda accessory plate
- 0-3 lambda accessory plate

Zeiss Standard WL Microscope (BLUE)
- stand
- condenser carrier
- auxiliary lens
- rotary polarizer
- condenser w/ swing-out front lens: 0.9
- stage (petrographic)
- mechanical stage
- intermediate body (petrographic)
- rotary analyzer
- objective turret
- triocular tube
- 2.5X Plan objective
- 10X Pol objective
- 25X Neofluar objective
- 40X Pol objective
- 63X Neofluar objective
- KPL 10X wide oculars
- 6 volt power supply
- 6-12 volt power supply
- illuminator w/ power cord
- blue filter
- lambda accessory plate
- 1/4 lambda accessory plate
- 0-3 lambda accessory plate
- epi-condenser (incident light attachment)
- 4X Epiplan objective
- 8X Epiplan objective
- 16X Epiplan objective
- 40X Epiplan objective
- polarizer w/ heat shield filter insert
- blue/green filter insert
- illuminator 30

Additional Equipment

Accessories
- stereoscope drawing tube (GRAY/OR/GRN)
- microscope drawing tube (RED/LG/BLU)
- AO stereomicroscope illuminator (RED/RD)
- AO stereomicroscope illuminator (GRN/GN)
- rubber eye cups (12 each)
- plastic eye shields (8 each)
- S-KPL 10X/20 ocular (GRN/GD/GRY/YEL)
- KPL 10X wide ocular (RED/GOLD/BLU/LG)
- KPL 16X/12 oculars (GRN/GRAY/BLU/LG)
- KPL 16X stereo eyepieces
- KPL 25X focusing stereo eyepieces
- 3.2X Plan (Pol) objective (YEL/ORANGE)
- 10X Pol objective (Achromat) (YEL/ORNG)
- 16X Epiplan (dry) objective (YEL/ORANGE)
- 16X Neofluar objective (YEL/ORANGE)
- 25X Neofluar (Pol) (dry) objective (YEL/OR)
- PH2 25X Neofluar objective (W/LG/GY/YL)
- 40X Pol (Achromat) objective (YEL/OR)
- 63X Achromat (Pol) (dry) objective (YL/OR)
- 100X Pol objective (RED/LG/BLUE/YEL)
- England finder slide (RED/BLU/OR/WHITE)
- England finder slide (YELLOW/BLU/LG/OR)
- micrometer (GOLD/WHITE/GREEN/RED)
- micrometer (BLUE/YELLOW/GRY/WT)
- condenser lens (1.4) for Nomarski DIC (2 ea.)
- diaphragm inserts (2 each)

Television Camera Systems
- Sony TV camera (GREEN/WHITE/GOLD)
  Sony trinitron monitor
  Sony camera control unit
- Sony TV camera (GRAY/YELLOW/BLUE)
  Sony trinitron monitor
  Sony camera control unit

Video Screen Printers
- Mitsubishi black and white screen printer
- Hitachi color screen printer

Photographic Equipment
- stereomicroscope photo tube (BL/WHT/GRY)
- 10X wide objective (BLUE/WHITE/GRAY)
- stereomicroscope photo tube (RED/OR/YEL)
- 10X wide objective (RED/OR/YELLOW)
- stereomicroscope photo tube (YEL/LG/GRN)
- 10X wide objective (YELLOW/LG/GREEN)
- 35 mm camera mount (BLUE/RED/GREEN)
- 35 mm camera mount (YEL/BLU/GOLD)
- 35 mm camera mount (WHITE/LTGRN/OR)
- MC 63 camera system (RED/YEL/GOLD)
  exposure control
  shutter unit
  35mm camera back
  4 X 5 camera back
  Polaroid film holder
  Polaroid film template
- OM-4 35mm camera (GRAY/YEL/LTGRN)
  data back
  cable release
- OM-4 35mm camera (WHITE/RED/GOLD)
  data back
  cable release
- film cranks (5 each)
- cable release

OPTICAL TECHNIQUES - ZEISS WL AND PHOTOMICROSCOPE III

Introduction

Information presented in this section is intended as a brief guide to the optical equipment for paleontology available in the microscope lab aboard *JOIDES Resolution*. Further details regarding the microscopes may be found in the numerous Zeiss manuals available aboard ship (Appendix 5); also, the Zeiss book "Microscopy from the Very Beginning" by F. K. Mollring discusses at greater length many of the topics introduced here. Much of the following text was provided by Mr. Butch Moomaw of Zeiss.

Objectives

The objectives on the Zeiss WL and Photomicroscope III microscopes are factory-engraved with a series of letters and numbers identifying the type of objective, initial magnification, numerical aperture, tube length, and cover glass thickness for optimum results. For example,

Plan 40/0.65
160/0.17

indicates initial magnification of 40X, numerical aperture of 0.65, tube length of 160 mm (the distance between the objective flange and the eyepiece seating face) and cover glass thickness of 0.17±0.01 mm. A "-" for the cover glass thickness indicates that the objective is insensitive to larger deviations of thickness. Some objective types are:

Plan - Planachromat (flat-field achromat, designed to minimize or eliminate chromatic aberration in the red or blue colors).

Neofluar - High-aperture objective with improved color rendition, high contrast but without flat field.

Planapo - Planapochromat (flat field apochromat, highly corrected for chromatic and spherical aberrations in all 3 primary colors).

Epiplan - Flat-field objective for vertical brightfield illumination.

Epiplan HD - Flat-field objective for vertical brightfield and darkfield illumination (in conjunction with concentric reflecting or refracting condenser).

POL - strain-free objective for polarized light microscopy.

Ph 2 - phase-contrast objective for diaphragm 2 of the phase-contrast condensers.

m.i. - objective with iris diaphragm, also suited for transmitted darkfield illumination.

Korr. - high-aperture objective with correction collar to allow for different cover-glass thicknesses.

Objectives in the Zeiss WL and Photomicroscope III microscopes are parfocal, which means that they are designed so that the distance between the specimen and the image remains constant. Only slight refocusing with the fine adjustment is needed to restore sharpness after changing objectives (objectives should be changed by rotating the nosepiece ring, never by grabbing the objectives themselves).

The shipboard microscopes are protected against damage to the slide or objective when these are brought into contact because a built-in spring yields to pressure. Nevertheless, care must be taken in their usage, and the practice of focusing by increasing focal distance should be followed rather than focusing down onto a slide.

Eyepieces

Two types of eyepieces are available on the shipboard scopes: a standard type and a special type for spectacle wearers. The special eyepieces accommodate the increased distance between eyepiece and eye which results from wearing eyeglasses; in addition, rubber guards prevent the eyeglass lens from being scratched. When these special eyepieces are used by non-eyeglass wearers, the eye must stay at an adequate distance from the eyepiece. Rubber eyecups can be of help in finding the correct distance.

Oil Immersion

Oil immersion places oil between the objective front lens and the cover glass of the slide, instead of air, in order to increase the numerical aperture (light-collecting ability) of the objective. For the same image scale, an oil immersion objective is always superior to a comparable dry objective.

To apply immersion oil, turn the oiler upside down to allow bubbles to rise, and apply a few drops to the cover glass of the slide. The objective is then moved down into the oil. If the specimen cannot be brought into focus, it is possible that a too-thick cover glass has been used, or that the space between the specimens and the cover glass (filled with mounting medium) is too great.

Kohler Illumination

In Kohler illumination, the light beam is focused (and its width defined) before reaching the sample. This results in even illumination across the entire light path. Some reasons for using Kohler illumination are that:

* It allows use of an inhomogeneous illumination source;
* Low voltage filament lamps can be used;
* It provides for contrast control in a specimen image by reducing flare;
* It provides maximum resolution by controlling the numerical aperture of the microscope system;
* With achromatic condensers, it provides the best system for photography.

The steps for setting up Kohler illumination are listed below:

* Clean the slide.
* Focus on a specimen with coarse and fine focus knobs at low power (10X).

* Close the field diaphragm by turning the knurled ring.
* Focus the image of the field diaphragm in the specimen plane by adjusting the condenser height with the knob, until the edges of the diaphragm leaves appear focused when viewed through the microscope.
* Center this image with the condenser centering screws.
* Open the field diaphragm by turning the ring until it just disappears from the field of view.
* Remove an eyepiece from the microscope body tube and look into the hole; the image visible is the image of the pupil planes of the microscope and is where the aperture diaphragm is imaged.
* Using the lever, open this aperture until the largest field of light possible is visible. Check for evenness of illumination. If the light intensity is not the same over the entire area, the lamp itself may need alignment (the Marine Technicians will do this).
* When the microscope pupil plane is evenly illuminated, close the aperture diaphragm with the lever until only 2/3 to 3/4 of the original field of illumination still appears.
* Reinsert the eyepiece and make final adjustments of the aperture diaphragm lever for best image quality.

Phase Contrast Illumination

Phase contrast illumination allows optical staining of objects with little or no amplitude differences. The steps for setting up phase contrast follow:
* Focus on the specimen using Kohler illumination.
* Switch to phase position in the condenser and align the phase annulus with the phase plate (it may be necessary to remove the specimen in order to do this).
* The aperture diaphragm may need to be realigned when going back to brightfield illumination.

To obtain better phase contrast:
* Choose a mounting medium of different refractive index than the specimen.
* Use a monochromatic filter, as it makes the wavefronts more uniform.
* Use thin specimens, as more "0" order light goes through the phase plate because of less diffraction and dispersion.

Nomarski Interference Contrast

Nomarski, or differential interference contrast (DIC), is identical to Kohler illumination with the addition of optical components to polarize the light and then split the polarized beam into two separate but close beams. These are then passed through the specimen, recombined, and rotated back into the same direction to form the microscope image.

The advantage to this type of system is that we can continuously change the way the two beams recombine and thus enhance the normally small differences in contrast in the specimen.

The steps for setting up differential interference are these:
* Focus on the specimen using Kohler illumination.
* Introduce a polarizer below the condenser with an east-west orientation.
* Introduce the first Nomarski prism above the polarizer at 45°.
* Introduce the second Nomarski prism behind the objective, rotated 180° from the direction of the first.
* Introduce the analyzer above the second Nomarski prism.
* Observe the specimen and adjust the contrast level to suit the specimen.
* Rotate the specimen to find the angle that produces the best contrast on the area of interest.

To improve differential interference:

* Open the aperture diaphragm a little more than for normal brightfield illumination.
* Always rotate the specimen before making a final evaluation of the specimen.
* Use oil immersion whenever possible to increase light intensity and contrast.

CHAPTER 4
DSDP/ODP DATABASES AND OTHER RESOURCES OF INTEREST TO PALEONTOLOGISTS

Several important paleontological databases are maintained by ODP, including data produced by Legs 1-96 of the Deep Sea Drilling Project. All of the DSDP data are available for use aboard *JOIDES Resolution;* the Computer Systems Manager can provide more detailed information.

Data may also be requested from ODP through the Data Librarian. Small requests can be answered quickly and free of charge; if a charge is made to recover expenses, an invoice will be sent and must be paid before the request is processed.

Also available from ODP are Data Announcements (updates on data availability), Data File Documents (information on specific ODP data files), and ODP Technical Note #9, "Deep Sea Drilling Project Data File Documents."

PALEONTOLOGY DATABASE

The DSDP Paleontology database (Appendix 6, excerpted from ODP Technical Note #9, "Deep Sea Drilling Project Data File Documents") contains abundance, preservation, and location information for 26 fossil groups, although only 21 are currently represented. The data source is Volumes 1-96 of the *Initial Reports of the Deep Sea Drilling Project.* Data from the *Proceedings of the Ocean Drilling Program, Scientific Results* will be added to an ODP Paleontology database as these volumes are completed. The ODP database contains abundance, preservation, location information, and biostratigraphic zones. The "fossil code dictionary" accompanies these databases, and consists of more than 12,000 fossil names.

AGEPROFILE DATABASE

The AGEPROFILE database for DSDP Legs 1-96 is based on the DSDP *Initial Reports* (Appendix 7, excerpted from ODP Technical Note #9, "Deep Sea Drilling Project Data File Documents") and contains definitions of age layers downhole. The AGEPROFILE database for ODP, beginning with Leg 101, contains definitions of age layers downhole, along with biostratigraphic zones, taken from the ODP *Proceedings*.

OTHER RELATED DATA AVAILABLE

ODASI: a file of ODP-affiliated scientists and institutions; can be cross-referenced and searched.

Keyword Index: a computer-searchable bibliography of DSDP- and ODP-related papers and studies in progress.

Site Location Map: DSDP and ODP site positions on a world map of ocean topography.

MICROPALEONTOLOGICAL REFERENCE CENTERS

Over the past two decades, the coring operations of the DSDP and its successor, the ODP, have recovered an enormous wealth of deep-sea material, providing scientists with important new biostratigraphic information from ocean basins around the world. Because core material may be gradually sampled out of existence, it is the primary goal of the Reference Centers to preserve material from important stratigraphic intervals for all time.

The establishment of identical paleontological reference collections around the world will help researchers to unify studies on pelagic biostratigraphy and paleoenvironments, and to stabilize taxonomy of planktonic microfossils. Researchers visiting these Centers may observe the quality of preservation and the richness of a large number of microfossils, enabling them to plan their own requests for either ODP or DSDP deep-sea samples more carefully. Visitors to the Centers also may compare actual, prepared faunas and floras (equivalent to type material) with figures and descriptions published in DSDP *Initial Reports* or ODP *Proceedings* volumes.

Located at eight sites on four continents, the Micropaleontological Reference Centers provide scientists around the world an opportunity to examine, describe, and photograph microfossils of various geologic ages and provenance. The collections contain specimens from four fossil groups -- foraminifers, calcareous nannofossils, radiolarians, and diatoms--selected from sediment samples obtained from the Deep Sea Drilling Project (DSDP). The processing of samples from DSDP Legs 1 through 82 has been overseen by John Saunders, Supervisor of the Western Europe Center, and William Riedel, Supervisor of the facility on the U.S. West Coast. These samples have been prepared, divided into eight identical splits, and distributed to each Center. Future plans include the addition of samples from the later Legs of DSDP, and from the Ocean Drilling Program (ODP) as well.

All fossil material maintained by the Reference Centers remains the property of the U.S.National Science Foundation and is held by the Centers on semipermanent loan.

Locations of the Micropaleontological Reference Centers

U.S. East Coast
Lamont-Doherty Geological Observatory
Palisades, NY 10964
Supervisor: Ms. Rusty Lotti
Telephone: (914) 359-2900
Telex: 7105762653 LAMONTGEO

U.S. National Museum
U.S. National Museum of Natural History
Dept. of Paleobiology
Smithsonian Institution
Washington, D.C. 20560
Supervisor: Dr. Martin Buzas
Telephone: (202)357-1390
Telex: 264729
Fax: (202)357-4779

U.S. Gulf Coast
Texas A&M University
Department of Oceanography
College Station, TX 77843
Supervisor: Dr. Stefan Gartner
Telephone: (409) 845-8479

Western Europe
Natural History Museum
CH-4001 Basel
Switzerland
Supervisor: Mr. John Saunders
Telephone: 061-29-55-64

USSR
Institute of the Lithosphere
Staromonet 22
Moscow 109180, USSR
Supervisor: Dr. Ivan Basov
Telephone: 231-48-36

Japan
National Science Museum
Dept. of Geology
3-23-1 Hyakunin-cho
Shinjuku-ku
Tokyo, 160, Japan
Supervisor: Dr. Y. Tanimura
Telephone: 03-364-2311
Telemail: 03-364-2316

U.S. West Coast
Scripps Institution of Oceanography
La Jolla, CA 92093
Supervisor: Dr. William Riedel
Telephone: (619) 534-4386
Telex: 910337127 IUC WWD SIOSDG

New Zealand
New Zealand Geological Survey
P.O. Box 30368
Lower Hutt
New Zealand
Supervisor: Dr. Tony Edwards
Telephone: (04) 699059
Fax: (04)691479

Facilities at the Centers

All of the Centers maintain complete, identical collections of microfossil specimens. In addition, the following materials and equipment are available for visitor use:

* secure storage and display areas
* binocular microscope and work space
* reference set of DSDP *Initial Reports* and ODP *Proceedings* volumes
* lithologic smear slides accompanying each fossil sample
* microfiche listings of samples available

For more information about the Reference Centers, or to schedule a visit, contact the Supervisor on site.

Appendix 1

OCEAN DRILLING PROGRAM SAMPLE REQUEST FOR SHIPBOARD AND SHOREBASED CRUISE PARTICIPANTS

(Submit to the Curator *at least two months* before cruise departs.)

Please be aware of the current sample distribution policy which is published in recent issues of *Initial Reports of the Deep Sea Drilling Project* and in *Proceedings of the Ocean Drilling Program.*

1. **Proposed leg name (include number if known):**

2. **Name(s), office address, telephone number, and telex number of investigator(s):**

3. **Purpose(s) of request. Please summarize the nature of the proposed research concisely in 5-7. [This summary will be included in various official reports.] Provide a detailed description of the proposed research, including techniques of sample preparation and analysis, roles of individual investigators, etc., on an attached sheet. The detailed description of the project will be employed in reviewing the sample request.**

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4. Please describe the proposed core sampling program in detail sufficient so that those who must carry it out onboard ship will understand your needs. Specify the size of samples (cubic centimeters); the number of samples to be taken from each section, core, and/or hole; particular stratigraphic or lithologic units to be sampled; special sampling techniques, equipment (for example, specialized tools which you are providing), storage or shipping requirements; or any other information that will be helpful in conducting your sampling program. Be aware that, if the number of samples which you are requesting is large, the taking of your samples is likely to be delayed until the cores reach the repository (4 to 6 months following the cruise), so it is to your advantage to keep the total number of samples small.

5. Are sufficient funds, space, and facilities now available to support the proposed research?

   Source of Funds:

   NSF: _____ Other (identify agency): _____

   Space: _____ Facilities: _____

   If funds, space, or facilities now available are inadequate, how do you anticipate remedying the situation? If a sample request is dependent, wholly or partially, upon propsed funding from the National Science Foundation, the sample request and funding proposal must be considered together; therefore, it is important that the funding proposal be submitted at the same time as this request.

   If NSF funding is to be employed in the proposed research, please enter the relevant NSF Grant No. _____ or NSF Proposal No. _____, and percent of funding in that grant which would be devoted to research on DSDP or ODP samples: _____ %

6. Please estimate the time it will require for you to obtain publishable results:

7. In what condition will the samples be once your research is complete? Will they be useful to others? If so, for what kinds of research?

8. If you have ever before received samples from DSDP or ODP, please indicate the ODP sample request number (if known), and the number and the volumes of samples received. Were all of these samples analyzed? If not, were they returned to DSDP/ODP? If work is still in progress, please attach a brief (2-3 page) progress report. If the work has ended, please return the samples. Micropaleontologists may keep their processed residues until their professional use of the samples is completed, whereupon they must be returned to the Curator.

9. If you have ever before received samples from DSDP or from ODP, please attach a comprehensive list of the publications in journals, outside of the ODP reprints, which resulted from each sample request. If you reference publications which have not yet been forwarded to the Curator, please enclose four (4) reprints of each. If work is still in progress, please attach a brief (2-3 page) progress report. If the work has ended, please return the residues.

10. Please summarize any other information which you feel would be useful in reviewing your request on an attached sheet.

11. If your samples will require special storage or shipment (for example, frozen organic samples) please specify a destination airport which is near your institute. Specify the name, telephone number, and telex number of someone who can: re-ice the shipment at the destination airport, clear the shipment from customs, and provide transportation to final destination.

12. Would you prefer that we:
    a) ship your samples to you,
    b) give them to you at the end of the cruise so that you can put them in your suitcase, or
    c) pack them in a box and give them to you at the end of the cruise?

Acceptance of samples implies willingness and responsibility on the part of the investigator to fulfill certain obligations:

(a) To publish significant results promptly; however, no contribution may be submitted for publication prior to twelve (12) months following the termination of the relevant leg unless it is approved and authored by the entire shipboard party.

(b) To acknowledge in all publications that the samples were supplied through the assistance of the International Ocean Drilling Program and others as appropriate.

(c) To submit (4) copies of reprints of all published works to the Curator, Ocean Drilling Program, Texas A&M Research Park, 1000 Discovery Drive, College Station, Texas 77840, U.S.A. These reprints will be distributed to the repositories, and to the ship. The Bibliographies of all reprints received by the Ocean Drilling Program will be sent to the National Science Foundation.

(d) To submit all final analytical data obtained from the samples to the Data Base Supervisor, Ocean Drilling Program, Texas A&M University Research Park, 1000 Discovery Drive, College Station, Texas 77840, U.S.A. Please consult recent issues of the *JOIDES Journal* or call 409-845-2673 for information on acceptable data formats. Investigators should be aware that they may have other data obligations under NSF's Ocean Science Data Policy or under relevant policies of other funding agencies which require submission of data to national data centers.

(e) To return all unused or residual samples, in good condition and with a detailed explanation of any processing they may have experienced, upon termination of the proposed research. In particular, all thin sections and smear slides manufactured onboard the vessel or in the repositories are to be returned to the Curator. Thin sections and smear slides used to describe the cores are unique representatives of the materials and as such they are kept as members of the ODP reference collection. All unused or dry residual paleontological materials may be returned either to the Curator at ODP or to one of designed paleontological reference centers upon completion of the investigators' use of the materials.

It is understood that failure to honor these obligations will prejudice future applications for samples.

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All requests will be reviewed by the Assistant Curator, by the ODP staff science representative, and by the Co-chief Scientists for the cruise, who will prepare a science study plan which will be submitted to the Curator for approval.

Approval/disapproval will be based upon the scientific requirements of the cruise as determined by the appropriate JOIDES advisory panel(s). In the case of duplicate proposals, shipboard scientists will have priority over shorebased scientists. Requests for samples for post-cruise studies will be handled separately.

Completion of this form in no way implies acceptance of your proposed investigation.

Date: _____ _____

Date: _____ _____

Date: _____ _____

Signatures of Investigators

* *

Send this completed form to the Curator ***at least two months*** in advance of the cruise departure date. The Curator's address:

Curator
Ocean Drilling Program
Texas A&M University Research Park
1000 Discovery Drive
College Station, Texas 77840
U.S.A.

OCEAN DRILLING PROGRAM SAMPLE REQUEST

Please be aware of the current sample distribution policy which is published in recent issues of *Initial Reports of the Deep Sea Drilling Project* and in *Proceedings of the Ocean Drilling Program.*

1. Name(s), office address, telephone number, and telex number of investigator(s):

2. Purpose(s) of request. Please summarize the nature of the proposed research concisely in 5-7 lines. [This summary will be included in various official reports.] Provide a detailed description of the proposed research, including techniques of sample preparation and analysis, roles of individual investigators, etc., on an attached sheet. The detailed description of the project will be employed in reviewing the sample request.

3. List the samples requested on an ODP Sample Request Inventory, specifying in detail the precise location of each sample within the core to the nearest centimeter, measured from the top of each section, and the sizes of samples which are the smallest required to support the research. Sample locations should be specified on the basis of the published lithological charts and descriptions which appear in the *Initial Reports* and the *Proceedings of the Ocean Drilling Program.*

4. Are sufficient funds, space and facilities now available to support the proposed research?

   Source of Funds:

   NSF: _____ Other (identify agency): _____

   Space: _____ Facilities: _____

   If funds, space, or facilities now available are inadequate, how do you anticipate remedying the situation? If a sample request is dependent, wholly or partially, upon proposed funding from the National Science Foundation, the sample request and funding proposal must be considered together; therefore, it is important that the funding proposal be submitted at the same time as this request.

(over)

If NSF funding is to be employed in the proposed research, please enter the relevant NSF Grant No. _____ or NSF Proposal No. _____, and percent of funding in that grant which would be devoted to research on DSDP or ODP samples: _____ %

5. Please estimate the time it will require for you to obtain publishable results:

6. In what condition will the samples be once your research is complete? Will they be useful to others? If so, for what kinds of research?

7. If you have ever before received samples from DSDP or ODP, please indicate the ODP sample request number (if known), and the number and the volumes of samples received. Were all of these samples analyzed? If not, were they returned to DSDP/ODP? If work is still in progress, please attach a brief (2-3 page) progress report. If the work has ended, please return the samples. Micropaleontologists may keep their processed residues until their professional use of the samples is completed, whereupon they must be returned to the Curator.

8. If you have ever before received samples from DSDP or from ODP, please attach a comprehensive list of the publications in journals, outside of the ODP reprints, which resulted from each sample request. If you reference publications which have not yet been forwarded to the Curator, please enclose four (4) reprints of each. If work is still in progress, please attach a brief (2-3 page) progress report. If the work has ended, please return the residues.

9. Please summarize any other information which you feel would be useful in reviewing your request below. [Attach sheets if needed.]

10. If your samples will require special storage or shipment (for example, frozen organic samples) please specify a destination airport which is near your institute. Specify the name, telephone number, and telex number of someone who can: re-ice the shipment at the destination airport, clear the shipment from customs, and provide transportation to final destination.

Acceptance of samples implies willingness and responsibility on the part of the investigator to fulfill certain obligations:

(a) To publish significant results promptly; however, no contribution may be submitted for publication prior to twleve (12) months following the termination of the relevant leg unless it is approved and authored by the entire shipboard party.

(b) To acknowledge in all publications that the samples were supplied through the assistance of the international Ocean Drilling Program and others as appropriate

(c) To submit (4) copies of reprints of all published works to the Curator, Ocean Drilling Program, Texas A&M Research Park, 1000 Discovery Drive, College Station, Texas 77840, U.S.A. These reprints will be distributed to the repositories and to the ship. The Bibliographies of all reprints received by the Ocean Drilling Program will be sent to the National Science Foundation.

(d) To submit all final analytical data obtained from the samples to the Data Base Supervisor, Ocean Drilling Program, Texas A&M University Research Park, 1000 Discovery Drive, College Station, Texas 77840, U.S.A. Please consult recent issues of the *JOIDES Journal* or call 409-845-2673 for information on acceptable data formats. Investigators should be aware that they may have other data obligations under NSF's Ocean Science Data Policy or under relevant policies of other funding agencies which require submission of data to national data centers.

(e) To return all unused or residual samples, in good condition and with a detailed explanation of any processing they may have experienced, upon termination of the proposed research. In particular, all thin sections and smear slides manufactured onboard the vessel or in the repositories are to be returned to the Curator. Thin sections and smear slides used to describe the cores are unique representatives of the materials and as such they are kept as members of the ODP reference collection. All unused or dry residual paleontological materials may be returned either to the Curator at ODP or to one of designated paleontological reference centers upon completion of the investigators' use of the materials.

It is understood that failure to honor these obligations will prejudice future applications for samples.

Date: _____ _____

Date: _____ _____

Date: _____ _____

Signatures of Investigators

Send completed forms to:

Curator
Ocean Drilling Program
Texas A&M University Research Park
1000 Discovery Drive
College Station, Texas 77840
U.S.A.

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ODP SAMPLE REQUEST INVENTORY

Name ______________________________ *Page* ____ *of* ____

Date of Request ____________________ *Number of Samples Requested* ________

LEG	SITE/ HOLE	CORE	SECTION	INTERVAL cm.*	VOLUME cu. cm.	PIECE NO. (HARD ROCK)	COMMENTS

* *For specifying these intervals, please refer to the published schematic lithologic columns for each core, rather than to the core photographs, because many of the latter are wrongly placed in relation to the meter scales.*

APPENDIX 3: SPECIES LISTS

SPECIES LIST I
NANNOFOSSILS

STRATIGRAPHICALLY USEFUL NEOGENE CALCAREOUS NANNOFOSSILS

Amaurolithus amplificus
Amaurolithus bizzarus
Amaurolithus delicatus
Amaurolithus tricorniculatus

Braarudosphaera discula
Braarudosphaera rosa

Bramletteius serraculoides

Calcidiscus leptoporus
Calcidiscus macintyrei

Catinaster calyculus
Catinaster coalitus

Campylosphaera dela
Campylosphaera eodela

Ceratolithus acutus
Ceratolithus armatus
Ceratolithus cristatus
Ceratolithus rugosus
Ceratolithus separatus

Chiasmolithus altus
Chiasmolithus bidens
Chiasmolithus califonicus
Chiasmolithus consuetus
Chiasmolithus danicus
Chiasmolithus expansus
Chiasmolithus gigas
Chiasmolithus grandis
Chiasmolithus oamaruenis
Chiasmolithus solitus

Coccolithus eopelagicus
Coccolithus miopelagicus
Coccolithus pelagicus
Coccolithus subdisticha

Crenalithus doronicoides

Cruciplacolithus neohelis
Cruciplacolithus primus
Cruciplacolithus tenuis

Cyclicargolithus abisectus
Cyclicargolithus floridanus

Dictyicaccites bisecta
Dictyococcites scrippsae
Dictyocaccites scissura

Discoaster asymmetricus
Discoaster aulakos
Discoaster barbadiensis
Discoaster bellus
Discoaster berggrenii
Discoaster bifax
Discoaster binodosus
Discoaster bollii
Discoaster braarudii
Discoaster brouweri
Discoaster calcaris.
Discoaster challengeri
Discoaster delicatus
Discoaster druggii
Discoaster exilis
Discoaster formosus
Discoaster gemmeus
Discoaster hamatus
Discoaster intercalaris
Discoaster kuepperi
Discoaster kugleri
Discoaster lautus
Discoaster lenticularis
Discoaster lidzii
Discoaster lodoensis
Discoaster loeblichii
Discoaster mediosus
Discoaster megastypus
Discoaster mohleri
Discoaster multiradiatus
Discoaster neorectus
Discoaster neohamatus
Discoaster nodifer
Discoaster nonaradiatus
Discoaster okadai

APPENDIX 3: SPECIES LISTS

Discoaster pentaradiatus
Discoaster pseudovariabilis
Discoaster quinqueramus
Discoaster saipanensis
Discoaster sanmiguelemsis
Discoaster saundersi
Discoaster signus
Discoaster sublodoensis
Discoaster surculus
Discoaster tamalis
Discoaster tanii
Discoaster tridenus
Discoaster triradiatus
Discoaster variabilis
Discoaster wemmelensis

Ellipsolithus distichus

Emiliania annula
Emiliania fenestrata
Emiliania huxleyi
Emiliania ovata
Emiliania subdisticha

Fasciculithus tympaniformis

Gephyrocapsa aperta
Gephyrocapsa caribbeanica
Gephyrocapsa oceanica
Gephyrocapsa omega

Heliolithus kleinpelli
Heliolithus riedelii

Helicosphaera ampliaperta
Helicosphaera carteri
Helicosphaera compacta
Helicosphaera euphratis
Helicosphaera kamptneri
Helicosphaera lophota
Helicosphaera heezenii
Helicosphaera intermedia
Helicosphaera wallichii
Helicosphaera recta
Helicosphaera reticulata
Helicosphaera rhomba
Helicosphaera obliqua
Helicosphaera sellii
Helicosphaera seminulum

Isthmolithus recurvus

Lophodolithus acutus
Lophodolithus mochlophorus
Lophodolithus nascens
Lophodolithus rotundus

Markalius asteroporus

Micrantholithus aequalis
Micrantholithus enaequalis
Micrantholithus inversus
Micrantholithus procerus

Minylitha convallis

Nannotetrina alata

Neochiastozygus diastypus
Neochiastozygus distentus

Oolithotus antillarium

Orthorhabdus serratus

Pontosphaera anisotrema
Pontosphaera distincta
Pontosphaera millepuncta
Pontosphaera segmenta

Prinsius martinii

Pseudoemiliania lacunosa

Reticulofenestra gartneri
Reticulofenestra hesslandii
Reticulofenestra hillae
Reticulofenestra clavigera
Reticulofenestra oamaruensis
Reticulofenestra placomorpha
Reticulofenestra pseudoumbilica
Reticulofenestra reticulata
Reticulofenestra samodurovii
Reticulofenestra umbilica

Rhabdosphaera inflata
Rhabdosphaera stylifera

APPENDIX 3: SPECIES LISTS

Rhomboaster cuspis

Sphenolithus abies
Sphenolithus anarrhopus
Sphenolithus belemnos
Sphenolithus capricornutus
Sphenolithus ciperoensis
Sphenolithus conicus
Sphenolithus delphix
Sphenolithus distentus
Sphenolithus furcatolighoides
Sphenolithus heteromorphus
Sphenolithus moriformis
Sphenolithus neoabies
Sphenolithus obtusus
Sphenolithus predistentus
Sphenolithus pseudoradians
Sphenolithus radians
Sphenolithus tribulosus
Toweius eminens
Toweius inversus

Tribrachiatus bramlettei
Tribrachiatus contortus
Tribrachiatus orthostylus

Triquetrorhabdulus carinatus
Triquetrorhabdulus inversus
Triquetrorhabdulus rugosus

Umbilicosphera irregularis
Umbilicosphera mirabilis
Umbilicosphera sibogae

Zygolithus dubius

Zygrhablithus bijugatus

STRATIGRAPHICALLY USEFUL CRETACEOUS CALCAREOUS NANNOFOSSILS

Arkhangelskiella cymbiformis
Arkhangelskiella specillata

Biantholithus sparsus

Braarudosphaera africana

Broinsonia bevieri
Broinsonia enormis
Broinsonia parca
Broinsonia signata

Calcicalathina oblongata

Chiastozygus amphipons
Chiastozygus cf. garrisonii
Chiastozygus litterarius

Conusphaera mexicana

Corollithion achylosum
Corollithion signum

Cretarhabdus angustiforatus
Cretarhabdus crenulatus
Cretarhabdus loriei

Cribrosphaera chiastia
Cribrosphaera conicus
Cribrosphaera coronadventis
Cribrosphaera coronatus
Cribrosphaera ehrenbergii
Cribrosphaera ellipticum
Cribrosphaera exiguum
Cribrosphaera primitiva
Cribrosphaera surirellus

Cruciellipsis cuvillieri

Cylindralithus asymmetricus
Cylindralithus gallicus
Cylindralithus serratus

Dodekapodorhabdus noelii

Eiffellithus eximius
Eiffellithus turriseiffeli

Ellipsogelosphaera britannica

Ellipsogelosphaera ovata
Ellipsogelosphaera paenepelagica

Flabellites oblonga

Gartnerago obliquum

APPENDIX 3: SPECIES LISTS

Gartnerago costatum

Hayesties radiatus
Hayesites albiensis

Kamptnerius punctatus
Kamptnerius magnificus

Lithastrinus floralils
Lithastrinus grillii

Lithraphidites alatus
Lithraphidites bollii
Lithraphidites carniolensis
Lithraphidites quadratus

Lucianorhabdus cayeuxi

Markalius astroporus

Marthasterites furcatus

Microrhabdulus decoratus

Micrantholithus obtusus

Micula mura
Micula staurophora

Nephrolithus frequens

Nicula praemurus

Parhabdolithus angustus
Parhabdolithus asper
Parhabdolithus embergeri

Podorhabdus albianus
Podorhabdus decorus

Polycostella beckmannii

Prediscosphaera cretacea

Quadrum gothicus
Quadrum trifidus

Reinhardites anthophorus
Reinhardites fenestratus

Rhagodiscus asper

Rucinolithus irregularis
Rucinolithus wisei

Stephanolithion laffittei

Tetralithus aculeus
Tetralithus malticus
Tetralithus obscurus

Thoracosphaera operculata

Tranolithus orionatus

Tubodiscus verenae

Vagalapilla matalosa
Vagalapilla octoradiata

Watznaueria barnesae

Zygodiscus adamas
Zygodiscus diplogrammus

APPENDIX 3: SPECIES LISTS

SPECIES LIST II
FORAMINIFERS

STRATIGRAPHICALLY USEFUL LATE MIOCENE TO HOLOCENE FORAMINIFERS

Candeina nitida

Globigerina apertura
Globigerina bermudezi
Globigerina bulloides
Globigerina calida
Globigerina druryi
Globigerina juvenilis
Globigerina nepenthes
Globigerina praecalida
Globigerina quinqueloba
Globigerina rubescens
Globigerina venezuelana
Globigerina woodi

Globigerinoides congolbatus
Globigerinoides elongatus
Globigerinoides fistulosus
Globigerinoides obliquus obliquus
Globigerinoides obliquus extremus
Globigerinoides quadrilobatus
Globigerinoides ruber (white)
Globigerinoides ruber (pink)
Globigerinoides sacculifer
Globigerinoides tenellus
Globigerinoides trilobus

Globorotalia conoidea
Globorotalia conomiozea
Globorotalia crassaformis
Globorotalia crassaformis ronda
Globorotalia crassaformis viola
Globorotalia fimbriata
Globorotalia hessi
Globorotalia inflata
Globorotalia juanai
Globorotalia lenguaensis
Globorotalia margaritae margaritae
Globorotalia margaritae evoluta
Globorotalia menardii cultrata
Globorotalia merotumida
Globorotalia miocenica
Globorotalia miotumida
Globorotalia miozea miozea
Globorotalia miozea cibaoensis
Globorotalia pseudomiocenica
Globorotalia puncticulata puncticulata
Globorotalia puncticulata padana
Globorotalia obesa
Globorotalia scitula
Globorotalia tosaensis
Globorotalia truncatulinoides
Globorotalia tumida tumida
Globorotalia tumida flexuosa
Globorotalia ungulata

Hastigerina pelagica
Hastigernia siphonifera

Neogloboquadrina acostaensis
Neogloboquadrina dutertrei
Neogloboquadrina humerosa
Neogloboquadrina pachyderma

Pulleniatina obliquiloculata
Pulleniatina primalis

Sphaeroidinella dehiscens
Sphaeroidinella subdehiscens

Sphaeroidinellopsis seminulina

STRATIGRAPHICALLY USEFUL OLIGOCENE TO MIOCENE FORAMINIFERS

Cassigerinella chipolensis

Catapsydrax dissimilis
Catapsydrax stainforthi

Globigerina ampliapertura
Globigerina angulisuturalis
Globigerina aungustiumbilicata
Globigerina ciperoensis
Globigerina juvenilis
Globigerina linaperta/angioporoides
Globigerina praebulloides

APPENDIX 3: SPECIES LISTS

Globigerina tripartita
Globigerina venezuelana
Globigerina woodi
Globigerina yeguaensis/galavisi

Globigerinatella insueta

Globigerinoides altiaperturus
Globigerinoides diminutus
Globigerinoides obliquus obliquus
Globigerinoides primordius
Globigerinoides quadrilobatus/immaturus
Globigerinoides sacculifer
Globigerinoides sicanus (=bisphericus)
Globigerinoides subquadratus
Globigerinoides trilobus

Globoquadrina altispira altispira
Globoquadrina globosa
Globoquadrina baroenoenensis
Globoquadrina dehiscens
Globoquadrina globularis
Globoquadrina praedehiscens

Globorotalia archaeomenardii
Globorotalia conoidea
Globorotalia fohsi fohsi
Globorotalia lobata
Globorotalia peripheroronda
Globorotalia peripheroacuta
Globorotalia robusta
Globorotalia kugleri
Globorotalia lenguaensis
Globorotalia mayeri
Globorotalia mendacis/praekugleri
Globorotalia menardii
Globorotalia miotumida
Globorotalia miozea
Globorotalia munda/postcretacea
Globorotalia obesa
Globorotalia opima
Globorotalia opima nana
Globorotalia praemenardii
Globorotalia praescitula/scitula
Globorotalia siakensis
Globorotalia zealandica

Globorotaloides suteri
Globorotaloides variabilis

Hastigerina siphonifera

Orbulina suturalis
Orbulina universa

Praeorbulina glomerosa glomerosa
Praeorbulina glomerosa circularis
Praeorbulina glomerosa curva

Pseudohastigerina micra

Sphaeroidinella subdehiscens

Sphaeroidinellopsis barbadoensis seminulina

STRATIGRAPHICALLY USEFUL PALEOCENE TO EOCENE FORAMINIFERS

Round Margin Acarinids
- *broedermanni*
- *chascanona*
- *coalingensis*
- *gravelli*
- *guatemalensis*
- *mckannai*
- *pentacamerata*
- *rohri (=truncorotaloides)*
- *rotundimarginata*
- *rugosoaculeata*
- *soldadoensis*
- *soldadoensis angulosa*
- *tadjikistanensis*

Acute Margin Acarinids
- *bullbrooki*
- *esnaensis*
- *intermedia*
- *nitida*
- *primitiva*
- *pseudotopilensis*
- *spinuloinflata*
- *topilensis (=truncorotaloides)*
- *velascoensis (= "Globigerina")*

Catapsydrax dissimilis
Catapsydrax echinatus
Catapsydrax howei

APPENDIX 3: SPECIES LISTS

Catapsydrax univacus

Globigerinia corpulenta/cryptomphala
Globigerinia edita
Globigerinia eocaena
Globigerinia eocaenica/patagonica
Globigerinia eugubina
Globigerinia fringa
Globigerinia gortanii/turritilina
Globigerinia inaequispira
Globigerinia linaperta/angiporoides
Globigerinia officinalis (=parva)
Globigerinia praebulloides
Globigerinia spiralis
Globigerinia taroubaensis
Globigerinia triangularis
Globigerinia triloculinoides
Globigerinia tripartita
Globigerinia turgida
Globigerinia yeugaensis/galavisi

Acute-keeled margin Globorotaliids
- *morozovellids*
- *abundocamerata*
- *acuta*
- *aequa*
- *angulata*
- *aragonensis*
- *caucasica/crater*
- *conicotruncata*
- *convexa*
- *crassata*
- *edgari*
- *formosa*
- *gracilis*
- *indolensis*
- *kolkidica*
- *krimensis*
- *kubensis*
- *laevigata*
- *lehneri*
- *lensiformis*
- *marginodentata*
- *occlusa*
- *pusilla pusilla*
- *quetra*
- *similatilis*
- *spinulosa*
- *subbotinae*
- *velascoensis*
- *wilcoxensis*

Round Margin Globorotaliids
- *bolivariana*
- *collactea*
- *inconstans*
- *opima nana*
- *praecursoria*
- *prolata*
- *pseudobulloides*
- *quadrata*
- *trinidadensis*
- *uncinata*
- *whitei*

Smooth Wall Globorotaliids
- *cerroazulensis*
- *cocoaensis*
- *cunialensis*
- *frontosa*
- *pomeroli*
- *possagnoensis*
- *chapmani*
- *compressa*
- *ehrenbergi*
- *imitata*
- *munda/postcretace*
- *palmerae*
- *perelara*
- *planoconica*
- *pseudomenardii*
- *pseudoscitula*
- *reissi*
- *renzi*
- *varianta*

Hantkenina alabamensis
Hantkenina dumblei
Hantkenina inflata(=Cribrohantkenina)
Hantkenina longispina
Hantkenina mexicana

Heterohelicidae
- *Cheloguembelina crinita*
- *midwayensis*
- *wilcoxensis*

"Globigerina" senni

APPENDIX 3: SPECIES LISTS

"Globigerina" korotkovi
"Globigerina" rubriformis
"Globigerina" tropicalis
"Globigerina" mexicana barri
"Globigerina" kugleri
"Globigerina" mexicana
"Globigerina" semiinvoluta
"Globigerina" subconglobate curryi
"Globigerina" euganea
"Globigerina" luterbacheri
"Globigerina" micra
"Globigerina" subconglobata

Globoconusa daubjergensis

Pseudohastigerina cocaena
Pseudohastigerina micra
Pseudohastigerina wilcoxensis

Woodringina claytonensis
Woodringina hornerstownensis

STRATIGRAPHICALLY USEFUL APTIAN TO MAESTRICHTIAN FORAMINIFERS

Abathomphalus intermedius
Abathomphalus mayaroensis

Archaeoglobigerina blowi
Archaeoglobigerina bosquensis
Archaeoglobigerina cretacea
Archaeoglobigerina cretacea

Clavihedgergella moremani
Clavihedgergella simplex

Dicarinella concavata carinata
Dicarinella concavata concavata
Dicarinella concavata primitiva
Dicarinella imbricata

Gansserina gansseri

Globigerinelloides asper
Globigerinelloides bentonensis
Globigerinelloides caseyi
Globigerinelloides eaglefordensis
Globigerinelloides ehrenbergi
Globigerinelloides ferreolensis
Globigerinelloides maridalensis
Globigerinelloides prairiehillensis
Globigerinelloides ultramicrus
Globigerinelloides volutus
Globigerinelloides yaucoensis (=alvarezi)

Globotruncana aegyptiaca
Globotruncana arca
Globotruncana bulloides
Globotruncana churchi
Globotruncana lapparenti
Globotruncana linneiana
Globotruncana marginata
Globotruncana renzi
Globotruncana ventricosa

Globotruncanita calcarata
Globotruncanita conica
Globotruncanita elevata elevata
Globotruncanita elevata subspinosa
Globotruncanita stuarti
Globotruncanita stuartiformis

Globotruncanella havanensis (=citae)
Globotruncanella petaloidea

Hastigerinoides alexanderi

Hedbergella amabilis
Hedbergella bornholmensis
Hedbergella brittonensis
Hedbergella crassa
Hedbergella delrioensis
Hedbergella globigerinelloides
Hedbergella holmdelensis
Hedbergella infracretacea
Hedbergella loetterli
Hedbergella monmouthensis
Hedbergella paradubia
Hedbergella planispira
Hedbergella portsdownensis
Hedbergella simplicissima
Hedbergella trocoidea
Hedbergella washitensis

Heterohelicidae
pseudotextularia
deformis
intermedia

APPENDIX 3: SPECIES LISTS

Heterohelicidae (continued)
- *reussi*
- *striata*
- *planoglobulina*
- *acervulinoides*
- *glabrata*
- *multicamerata*
- *ornatissima*
- *pseudoguembelina costulata*
- *excolata*
- *palpebra*
- *glabrans*
- *globulosa*
- *navarroensis*
- *pulchra*
- *punctulata*

Heterohelix carinata

Marginotruncana pseudolinneiana
Marginotruncana scheegansi
Marginotruncaba sigali

Planomalina buxtorfi

Praeglobotruncana algeriana
Praeglobotruncana delrioensis
Praeglobotruncana hagni
Praeglobotruncana helvetica
Praeglobotruncana stephani stephani
Praeglobotruncana turbinata

Racemiguembelina fructicos

Rosita contusa
Rosita fornicata

Rotaliporida appenninica
Rotaliporida brotzeni
Rotaliporida cushmani
Rotaliporida evoluta
Rotaliporida gandolfii
Rotaliporida greenohornensis

Rugoglobigerina hantkeninoides
Rugoglobigerina hexacamerata
Rugoglobigerina macrocephala
Rugoglobigerina pilula
Rugoglobigerina rotundata
Rugoglobigerina rugosa
Rugoglobigerina scotti

Schakoina cenomana
Schakoina multispinata

Ticinella multicamerata
Ticinella primula
Ticinella raynaudi
Ticinella roberti
Ticinella subticinensis
Ticinella ticinensis

Whiteinella aprica
Whiteinella baltica
Whiteinella archaeocretacea

APPENDIX 3: SPECIES LISTS

SPECIES LIST III
DIATOMS

STRATIGRAPHICALLY USEFUL NEOGENE DIATOMS

Actinocyclus ellipticus Grunow
Actinocyclus ellipticus f. *lanceolatus* Kolbe
Actinocyclus ingens Rattray
Actinocyclus ingens f. *nodus* (Baldauf) Whiting and Schrader
Actinocyclus moronensis Deby
Actinocyclus oculatus Jousé

Annelus californicus Tempere

Asteromphalus elegans Greville

Azpeitia nodulifer Sims
Azpeitia oligocenicus (Jousé) Sims

Bogorovia veniamini Jousé

Cestodiscus peplum Brun
Cestodiscus pulchellus Greville

Coscinodiscus elliptopora Donahue
Coscinodiscus kolbei Jousé
Coscinodiscus lewisianus Greville
Coscinodiscus pustulatus Mann
Coscinodiscus rhombicus Castracane
Coscinodiscus temperei Brun
Coscinodiscus temperei var. *delicata* Barron
Coscinodiscus tuberculatus Greville
Coscinodiscus vetustissimus var. *javanica* Reinhold

Cosmiodiscus insignis Jousé

Craspedodiscus coscinodiscus Ehrenberg
Craspedodiscus elegans Ehrenberg

Denticulopsis dimorpha (Schrader) Simonsen
Denticulopsis hustedtii (Simonsen and Kanaya) Simonsen
Denticulopsis hyalina (Schrader) Simonsen
Denticulopsis kamtschatica (Zabelina) Simonsen
Denticulopsis kanayae (Akiba) Barron
Denticulopsis lauta (Bailey) Simonsen
Denticulopsis maccollumii Simonsen
Denticulopsis nicobarica (Grunow) Simonsen
Denticulopsis praedimorpha (Akiba) Akiba
Denticulopsis punctata f. *hustedtii* (Schrader) Simonsen
Denticulopsis seminae var. *fossilis* (Schrader) Simonsen

Hemidiscus cuneiformis Wallich
Hemidiscus karstenii Jousé

Lithodesmiun reynoldsii Barron

Mediaria splendida Sheshukova-Poretzkaya

Nitzschia angulata (O'Meara) Hasle
Nitzschia cylindrica Burckle
Nitzschia denticuloides Schrader
Nitzschia fossilis (Frenguelli) Kanaya and Koizumi
Nitzschia grossepunctata Schrader
Nitzschia interfrigidaria McCollum
Nitzschia jouseae Burckle
Nitzschia kerguelensis (O'Meara) Hasle
Nitzschia maleinterpretaria Schrader
Nitzschia marina Grunow
Nitzschia miocenica Burckle
Nitzschia porteri Frenguelli sensu Burckle
Nitzschia praeinterfrigidaria McCollum
Nitzschia reinholdii Kanaya and Koizumi

Pseudoeunotia doliolus (Wallich) Grunow

Pseudotriceratium radiosreticulatum (Grunow) Jousé

Raphidodiscus marylandicus Christian

Rhaphoneis fossile (Grunow) Andrews

Rhizosolenia barboi Brun

APPENDIX 3: SPECIES LISTS

Rhizosolenia curvirostris Jousé
Rhizosolenia norwegica Schrader
Rhizosolenia praebergonii Mukhina
Rhizosolenia praebergonii var. *robusta* Burckle and Trainer

Rocella gelida (Mann) Bukry

Rossiella paleacea (Grunow) Desikachary and Maheshwari
Rossiella tatsunokuchiensis (Koizumi) Gersonde

Rouxia californica Peragallo

Stephanopyxis horridus Koizumi

Synedra jouseana Sheshukova-Poretzkaya

Thalassionema schraderi Akiba

Thalassiosira antiqua (Grunow) Cleve-Euler
Thalassiosira bukryi Barron
Thalassiosira burckliana Schrader
Thalassiosira convexa Mukhina
Thalassiosira convexa var. *aspinosa* Schrader
Thalassiosira fraga Schrader
Thalassiosira aff. *irregulata* Schrader and Fenner
Thalassiosira lentigenosus Janisch
Thalassiosira miocenica Schrader
Thalassiosira nativa Sheshukova-Poretzkaya
Thalassiosira nidulus (Tempere and Brun) Jousé
Thalassiosira oestrupii (Ostenfeld) Proshkina-Lavrenko
Thalassiosira plicatus (Grunow) Akiba and Yanagisawa
Thalassiosira praeconvexa Burckle
Thalassiosira praeyabei (Schrader) Akiba and Yanagisawa
Thalassiosira primalabiata Gombos
Thalassiosira spinosa Schrader
Thalassiosira spumellaroides Schrader
Thalassiosira yabei (Kanaya) Akiba and Yanagisawa
Thalassiosira zabelinae Jousé

STRATIGRAPHICALLY USEFUL PALEOGENE DIATOM SPECIES

Asterolampra acutiloba Frenguelli
Asterolampra marylandica Ehrenberg

Asteromphalus symmetricus Schrader and Fenner

Baxteropsis brunii (van Heurck) Karsten

Bogorovia veniamini Jousé

Brightwellia hyperborea Grunow
Brightwellia imperfecta Jousé

Cestodiscus antarcticus Fenner
Cestodiscus pulchellus Greville
Cestodiscus reticulatus Fenner

Clavularia barbadensis Greville

Coscinodiscus excavatus Greville
Coscinodiscus oligocenicus Jousé
Coscinodiscus rhombicus Castracane

Craspedodiscus oblongus (Greville) A. Schmidt
Craspedodiscus undulatus Gombos

Cymatosira biharensis Pantocsek

Gladius pacificus Hajos and Stradner
Gladius speciosus Schulz

Hemiaulus alatus Greville
Hemiaulus dubius Grunow
Hemiaulus exiguus Greville
Hemiaulus gondolaformis Fenner
Hemiaulus grassus Fenner
Hemiaulus inequilaterus Gombos
Hemiaulus klushnikovii Gleser
Hemiaulus lyriformis Greville
Hemiaulus pacificus (Hajos) Gombos and Ciesielski
Hemiaulus polycystinorum var. *mesolepta* Grunow
Hemiaulus subacutus Grunow

Odontotropsis klavsenii Debes ex Hustedt

Pyxilla caput avis Brun
Pyxilla gracilis Tempere and Forti
Pyxilla oligocaenica Jousé
Pyxilla reticulata Grove and Sturt

Rhizosolenia antarctica Fenner
Rhizosolenia gravida Gombos and Ciesielski

Rocella gelida (Mann) Bukry
Rocella gelida var. *schraderi* (Bukry) Barron
Rocella vigilans (Kolbe) Fenner

Rossiella paleacea (Grunow) Desikachary and Maheshwari
Rossiella symmetrica Fenner
Rossiella tatsunokuchiensis (Koizumi) Gersonde

Rouxia granda Schrader
Rouxia hannae Jousé
Rouxia obesa Schrader

Rutilaria areolata Sheshukova

Rylandsia biradiata Greville
Rylandsia inaequiradiata Barker and Meakin

Sceptroneis pesplanus Fenner and Schrader
Sceptroneis pupa Schrader and Fenner

Skeletonema barbadense Greville

Stephanopyxis superba var. *trispinosa* Gombos

Synedra jouseana Sheshukova-Poretzkaya
Synedra jouseana f. *linearis* Sheshukova-Poretzkaya

Thalassiosira aff. *irregulata* Schrader

Triceratium inconspicuum var. *trilobata* Fenner
Triceratium kanayae Fenner

Trinacria excavata f. *tetragona* Schmidt

APPENDIX 3: SPECIES LISTS

SPECIES LIST IV
RADIOLARIANS

STRATIGRAPHICALLY USEFUL CENOZOIC RADIOLARIANS

Anthocyrtidium angulare

Artophormis barbadensis
Artophormis gracilis

Axoprunum angelinum

Bekoma bidartensis

Buccinosphaera invaginata

Buryellla clinata
Buryella tetradica

Calocycloma castum

Calocycletta costata
Calocycletta serrata
Calocycletta virginia

Calocyclas turris

Centrobotrys gravida
Centrobotrys petrushevskayae
Centrobotrys thermophila

Collosphaera tuberosa

Cryptoprora ornata

Cyrtocapsella cornuta
Cyrtocapsella tetrapera

Diartus hughesi
Diartus petterssoni

Dictyoprora mongolfieri
Dictyoprora pirum

Didymocyrtis antepenultima
Didymocyrtis avita
Didymocyrtis laticonus
Didymocyrtis mammifera
Didymocyrtis penultima
Didymocyrtis prismatica

Didymocyrtis tetrathalamus
Didymocyrtis tubaria
Didymocyrtis violina

Dorcadospyris alata
Dorcadospyris ateuchus
Dorcadospyris dentata
Dorcadospyris forcipata
Dorcadospyris papilio
Dorcadospyris pseudopapilio

Eusyringium fistuligerum
Eusyringium lagena

Lamprocyrtis neoheteroporos
Lamprocyrtis nigriniae

Lamptonium fabaeforme chaunothorax
Lamptonium fabaeforme constricutm
Lamptonium fabaeforme fabaeforme
Lamptonium pennatum
Lamptonium sanfilippoae

Liriospyris parkerae
Liriospyris stauropora

Lithocyclia angusta
Lithocyclia aristotelis
Lithocyclia crux
Lithocyclia ocellus

Lithopera bacca
Lithopera neotera
Lithopera renzae
Lithopera thornburgi

Lychnodictyum audax

Lychnocanoma bandyca
Lychnocanoma elongata
Lychnocanoma trifolium

APPENDIX 3: SPECIES LISTS

Phormocyrtis striata exquisita
Phormocyrtis striata striata

Phormostichoartus corbula
Phormostichoartus doliolum

Podocyrtis (Podocyrtis) ampla
Podocyrtis (Podocyrtis) diamesa
Podocyrtis (Podocyrtis) phyxis
Podocyrtis (Lampterium) chalara
Podocyrtis (Lampterium) fasciolata
Podocyrtis (Lampterium) goetheana
Podocyrtis (Lampterium) helenae
Podocyrtis (Lampterium) mitra
Podocyrtis (Lampterium) sinuosa
Podocyrtis (Lampterium) trachodes

Pterocanium prismatium

Pterocodon ampla

Sethochytris triconiscus

Solenosphaera omnitubus

Spongaster berminghami
Spongaster pentas
Spongaster tetras

Spongatractus balbis
Spongatractus pachystylus

Stichocorys delmontensis
Stichocorys peregrina
Stichocorys wolffii

Theocorys anaclasta

Thoecorythium trachelium dianae
Theocorythium trachelium trachlium
Theocorythium vetulum

Theocotyle conica
Theocotyle cryptocephala
Theocotyle nigriniae
Theocotyle venezuelensis

Theocotylissa alpha
Theocotylissa auctor
Theocotylissa ficus
Theocotylissa fimbria

Theocyrtis tuberosa

Tristylospyris triceros

Thyrsocyrtis (Thyrsocyrtis) bromia
Thyrsocyrtis (Thyrsocyrtis) hirsuta
Thyrsocyrtis (Thyrsocyrtis) rhizodon
Thyrsocyrtis (Thyrsocyrtis) robusta
Thyrsocyrtis (Thyrsocyrtis) tarsipes
Thyrsocyrtis (Pentalacorys) lochites
Thyrsocyrtis (Pentalacorys) tensa
Thyrsocyrtis (Pentalacorys) tetracantha
Thyrsocyrtis (Pentalacorys) triacantha

STRATIGRAPHICALLY USEFUL CRETACEOUS RADIOLARIANS

Acaeniotyle diaphorogona
Acaeniotyle umbilicata

Acanthocircus dicranacanthos
Acanthocircus trizonalis

Afens liriodes

Alievium gallowayi
Alievium superbum

Amphipyndax pseudoconulus

Archaeodictyomitra lacrimula
Archaeodictyomitra lamellicostata

Crolanium pythiae

Clathropyrgus titthium

Cryptamphorella conara

Dibolachras tytthopora

Dictyomitra koslovae s.l.

Eucyrtidium ptyctum

APPENDIX 3: SPECIES LISTS

Eucyrtis columbaria
Eucyrtis hanni s.l.
Eucyrtis micropora
Eucyrtis tenuis

Foremanella diamphidia
Foremanella hipposidericus

Holocryptocanium barbui

Mirifusus mediodilatatus

Myllocercion acineton

Obesacapsula somphedia

Podobursa pantanellii
Podobursa triacantha
Podobursa tricola
Podocapsa amphitreptera

Pseudoaulophacus floresensis
Pseudoaulophacus lenticulatus
Pseudoaulophacus pargueraensis

Pseudodictyomitra pseudomacrocephala

Sethocapsa cetia
Sethocapsa trachyostraca
Sethocapsa uterculus

Siphocampe bassilis
Siphocampe daseia

Solenotryma dacryodes s.l.

Sphaerostylus lanceola
Sphaerostylus septemporatus

Stichocapsa euganea

Thanarla elegantissima
Thanarla pulchra
Thanarla veneta

Theocampe apicata s.s.
Theocampe ascalia
Theocampe salillum s.s.
Theocampe tina
Theocampe urna

Theocapsomma comys gp.

APPENDIX 3: SPECIES LISTS

SPECIES LIST V
SILICOFLAGELLATES

STRATIGRAPHICALLY USEFUL NEOGENE SILICOFLAGELLATES

Corbisema triacantha var. *nuda* Bukry

Dictyocha aegea Stradner et Bachmann
Dictyocha angulata Bukry
Dictyocha arbutusensis Bukry
Dictyocha aspera aspera (Lemmermann) Bukry et Foster
Dictyocha aspera var. *pygmaea* Ciesielski
Dictyocha bachmannii Dumitrica
Dictyocha brevispina ausonia (Deflandre) Bukry
Dictyocha brevispina brevispina (Lemmermann) Bukry
Dictyocha calida ampliata Bukry
Dictyocha calida calida Poelchau
Dictyocha complexa (Tsumura) Ling
Dictyocha concavata Dumitrica
Dictyocha concinna Bukry
Dictyocha constricta (Schulz) Bukry
Dictyocha delicata (Bukry) Bukry
Dictyocha delicata var. *bisecta* Bukry
Dictyocha fibula augusta Bukry
Dictyocha flexatella (Bukry) Bukry
Dictyocha frenguellii Deflandre
Dictyocha grandis Ciesielski et Shaw
Dictyocha helix Bukry
Dictyocha hexacantha Schulz
Dictyocha japonica Deflandre
Dictyocha longa Bukry
Dictyocha longa var. *paxilla* Bukry
Dictyocha longispina (Lemmermann) Bukry
Dictyocha neonautica Bukry
Dictyocha neonautica var. cocosensis Bukry
Dictyocha ornata africana Bukry
Dictyocha ornata ornata (Bukry) Bukry
Dictyocha perfecta Bukry
Dictyocha perlaevis Frenguelli
Dictyocha pons Ehrenberg
Dictyocha precarentis Bukry
Dictyocha pulchella Bukry
Dictyocha pulchella var. *inflata* Bukry
Dictyocha pumila Ciesielski
Dictyocha quadrangula (Bachmann) Bukry
Dictyocha rotundata secta Glezer
Dictyocha spinosa (Deflandre) Glezer
Dictyocha stelliformis Shaw et Ciesielski
Dictyocha stapedia aspinosa Bukry
Dictyocha stapedia stapedia Haeckel
Dictyocha subaculeata (Bukry) Bukry

Dictyocha subarctios Ling
Dictyocha subclinata Bukry
Dictyocha tamarae Bukry
Dictyocha transenna Bukry
Dictyocha varia Locker
Dictyocha vexativa Bukry

Distephanus boliviensis (Frenguelli) Bukry et Foster
Distephanus crux bispinosus Dumitrica
Distephanus crux carolae Bukry
Distephanus crux parvus (Bachmann) Bukry
Distephanus crux scutulatus Bukry
Distephanus floridus Bukry
Distephanus frugalis (Bukry) Bukry
Distephanus hannai (Bukry) Bukry
Distephanus jimlingii (Bukry) Bukry
Distephanus longispinus (Schulz) Bukry et Foster
Distephanus major (Frenguelli) Bukry
Distephanus mesophthalmus (Ehrenberg) Haeckel
Distephanus octangulatus Wailes
Distephanus polyactis (Ehrenberg) Deflandre
Distephanus pseudocrux (Schulz) Ling
Distephanus pseudofibula (Schulz) Bukry
Distephanus quintus (Bukry et Foster) Bukry
Distephanus raupii Bukry
Distephanus schauinslandii Lemmermann
Distephanus slavnicii (Jerkovic') Bukry
Distephanus speculum bispicatus Bukry
Distephanus speculum f. *coronata* Schulz
Distephanus speculum diommata (Ehrenberg) Bukry
Distephanus speculum elongatus Bukry
Distephanus speculum giganteus Bukry
Distephanus speculum haliomma (Ehrenberg) Bukry
Distephanus speculum hemisphaericus (Ehrenberg) Bukry

APPENDIX 3: SPECIES LISTS

Distephanus speculum minutus (Bachmann) Bukry
Distephanus speculum patulus Bukry
Distephanus speculum polyommata (Schulz) Bukry
Distephanus speculum tenuis Bukry
Distephanus speculum triommata (Ehrenberg) Bukry
Distephanus speculum varians (Gran et Braarud) Bukry
Distephanus stauracanthus (Ehrenberg) Haeckel
Distephanus staurodon (Ehrenberg) Bukry
Distephanus stradneri (Jerkovic') Bukry
Distephanus stradneri var. *grandis* Bukry
Distephanus sulcatus Bukry
Distephanus trioctus Bukry
Distephanus xenus Bukry
Mesocena apiculata apiculata (Schulz) Bukry
Mesocena apiculata curvata Bukry
Mesocena apiculata evexa Bukry
Mesocena apiculata glabra (Schulz) Bukry
Mesocena circulus (Ehrenberg) Ehrenberg
Mesocena circulus var. *apiculata* Lemmermann
Mesocena diodon borderlandensis Bukry
Mesocena diodon diodon Ehrenberg
Mesocena diodon nodosa Bukry
Mesocena dumitricae (Perch-Nielsen) Bukry
Mesocena elliptica (Ehrenberg) Ehrenberg
Mesocena elliptica var. *rhomboidea* Bukry
Mesocena hexalitha Bukry
Mesocena oamaruensis var. *quadrangula* Schulz
Mesocena pappii Bachmann
Mesocena quadrangula Ehrenberg ex Haeckel
Mesocena triangula (Ehrenberg) Ehrenberg
Mesocena triodon Bukry

Naviculopsis contraria Bukry
Naviculopsis lacrima Bukry
Naviculopsis lata (Deflandre) Frenguelli
Naviculopsis lata var. *obliqua* Bukry
Naviculopsis navicula (Ehrenbrg) Deflandre
Naviculopsis obtusarca Bukry
Naviculopsis obtusarca var. *acicula* Bukry
Naviculopsis pacifica pacifica (Dumitrica) Bukry
Naviculopsis pacifica pansa Bukry
Naviculopsis ponticula ponticula (Ehrenberg) Bukry
Naviculopsis ponticula spinosa Bukry
Naviculopsis quadrata (Ehrenberg) Ling

STRATIGRAPHICALLY USEFUL PALEOGENE SILICOFLAGELLATES

Corbisema angularis Bukry
Corbisema apiculata (Lemmermann) Hanna
Corbisema archangelskiana (Schulz) Frenguelli
Corbisema bimucronata bimucronata Deflandre
Corbisema bimucronata rotatoria Bukry
Corbisema bukryi Jousé
Corbisema disymmetrica angulata Bukry
Corbisema disymmetrica communis Bukry
Corbisema disymmetrica disymmetrica (Dumitrica) Bukry
Corbisema ellipsis Dumoulin
Corbisema falklandensis Bukry
Corbisema flexuosa (Stradner) Perch-Nielson
Corbisema glezerae Bukry
Corbisema hastata cunicula Bukry
Corbisema hastata globulata Bukry
Corbisema hastata hastata (Lemmermann) Frenguelli
Corbisema hastata miranda Bukry
Corbisema inermis ballantina Bukry
Corbisema inermis inermis (Lemmermann) Bukry
Corbisema inermis minor (Glezer) Bukry
Corbisema katharinae Bukry
Corbisema lamellifera (Glezer) Bukry
Corbisema neoparallela Bukry
Corbisema ovalis Perch-Nielsen
Corbisema panda Bukry
Corbisema recta Schulz
Corbisema regina Bukry
Corbisema triacantha convexa Bukry
Corbisema triacantha mediana Bukry

Dictyocha alta Ciesielski
Dictyocha anguinea Ciesielski et Shaw
Dictyocha aspera clinata Bukry
Dictyocha aspera martinii
Dictyocha byronalis Bukry
Dictyocha challengeri Martini et Muller
Dictyocha deflandrei bicornuta Glezer
Dictyocha deflandrei completa Glezer
Dictyocha deflandrei deflandrei Frenguelli ex Glezer

Dictyocha deflandrei lobata Bukry
Dictyocha deflandrei producta (Glezer) Bukry
Dictyocha dickii Dumoulin
Dictyocha elongata Glezer

APPENDIX 3: SPECIES LISTS

Dictyocha fibula formicata Bukry
Dictyocha fibula f. *rectangularis* Ichikawa
Dictyocha fischeri Bukry
Dictyocha torta Martini et Muller
Dictyocha transitoria Deflandre

Distephanus antiquus Glezer
Distephanus crux darwinii Bukry
Distephanus crux loeblichii Bukry
Distephanus crux paulii Shaw et Ciesielski
Distephanus norvegiensis Perch-Nielsen
Distephanus raupii Bukry
Distephanus rosae Perch-Nielsen
Distephanus speculum patulus Bukry
Distephanus speculum haliomma (Ehrenberg) Bukry

Mesocena apiculata apiculata (Schulz) Bukry
Mesocena apiculata evexa Bukry
Mesocena apiculata glabra (Schulz) Bukry
Mesocena apiculata inflata Bukry
Mesocena bispicata Ciesielski
Mesocena concava Perch-Nielsen
Mesocena connudata Bukry
Mesocena muticata Glezer
Mesocena oamaruensis Schulz
Mesocena oamaruensis var. *quadrangula* Schulz
Mesocena occidentalis Hanna ex Bukry
Mesocena ovata Bukry
Mesocena pappii Bachmann
Mesocena venusta Bukry

Naviculopsis americana Bukry
Naviculopsis aspera (Schulz) Perch-Nielsen
Naviculopsis biapiculata (Lemmermann) Bukry
Naviculopsis constricta (Schulz) Bukry
Naviculopsis danica Perch-Nielsen
Naviculopsis eobiapiculata Bukry
Naviculopsis foliacea foliacea Deflandre
Naviculopsis foliacea tumida Bukry
Naviculopsis lata (Deflandre) Frenguelli
Naviculopsis minor (Schulz) Bukry
Naviculopsis nordica nordica Bukry
Naviculopsis nordica hyalina Bukry
Naviculopsis pacifica pacifica (Dumitrica) Bukry
Naviculopsis pacifica pansa Bukry
Naviculopsis punctilia punctilia Perch-Nielsen
Naviculopsis punctilia taenia Bukry
Naviculopsis robusta Deflandre
Naviculopsis trispinosa (Schulz) Glezer
Naviculopsis vemae Perch-Nielsen

STRATIGRAPHICALLY USEFUL CRETACEOUS SILICOFLAGELLATES

Arctyocha quadralra (Hanna) Bukry

Corbisema geometrica geometrica Hanna
Corbisema geometrica lateradiata (Schulz) Bukry
Corbisema apiculate (Lemmermann) Hanna
Corbisema archangelskiana (Schulz) Frenguelli

Cornua aculeifera Deflandre
Cornua poretzkiae Glezer
Cornua trifurcata Schulz

Distephanus furcata Jousé

Lyramula arctica Bukry
Lyramula burchardae Bukry
Lyramula deflandrei Perch-Nielsen et Edwards
Lyramula furcula Hanna
Lyramula minor (Deflandre) Deflandre
Lyramula porta Bukry
Lyramula simplex Hanna

Vallacerta hannai Deflandre
Vallacerta hortonii Hanna
Vallacerta quadrata Hajos
Vallacerta siderea (Schulz) Bukry
Vallacerta tumidula Glezer

APPENDIX 4: LIST OF BOOKS FOR PALEONTOLOGISTS ABOARD JOIDES RESOLUTION

The following books, intended for use in species identification and biostratigraphic interpretation, are housed in the Microscope Lab. Additional references concerning paleontological topics of broader interest, along with the shipboard reprint collection (not listed below), are kept in the Shipboard Library.

QE 1 C15 v. 43	Kleinpell, Robert M., and Weaver, D. W. Oligocene Biostratigraphy of the Santa Barbara Embayment, California.
QE 268 C82 1961	Cuvillier, J. Stratigraphic Correlations by Microfacies in Western Aquitaine.
QE 320 J68 v. 5 1986	Kogbe, C. A., and Mehes, K. Micropaleontology and Biostratigraphy of the Coastal Basins of West Africa.
QE 350.5 I53	Heirtzler, J. R., et al., eds. Indian Ocean Geology and Biostratigraphy: Studies Following Deep-Sea Drilling Legs 22-29.
QE 420 F57 no. 32	Geitzenauer, Kurt R. The Pleistocene Calcareous Nannoplankton of the Subantarctic Pacific Ocean.
QE 451 I8 C5	Cita, Maria B. Jurassic, Cretaceous and Tertiary Microfacies from the Southern Alps (Northern Italy).
QE 471 P37	Perconig, Enrico. Microfacies of the Triassic and Jurassic Sediments of Spain.
QE 651 C67	Kauffman, Erle G., and Hazel, Joseph E., eds. Concepts and Methods of Biostratigraphy.
QE 675 G7	Grunau, Hans R. Mikrofazies und Schichtung Ausgewahlter, Jungmesozoischer, Radiolarit-fuhrender Sedimentserien der Zentral-Alpen: mit Berucksichtigung Elektronenmikroskopischer und Chemischer Untersuchungsmethoden.
QE 692.2 M32	McDougall, Kristen A. Paleoecological Evaluation of Late Eocene Biostratigraphic Zonations of the Pacific Coast of North America.
QE 694 K58 1980	Kleinpell, Robert M., and Haller, C. R. The Miocene Stratigraphy of California Revisited.
QE 696 I69	Clines, R. M., and Hays, J. D. Investigation of Late Quaternary Paleoceanography and Climatology.

QE 696 L37	Saito, Tsunemasa, and Burckle, Lloyd H., eds. Late Neogene Epoch Boundaries (papers of the Symposium on Late Neogene Epoch Boundaries, 24th International Geological Congress, Montreal, 21-30 August 1972).
QE 697 P84 1984	Healy-Williams, Nancy. Principles of Pleistocene Stratigraphy Applied to the Gulf of Mexico.
QE 70 R67 1974b	Rosenberg-Herman, Yvonne. Marine Geology and Oceanography of Arctic Seas.
QE 701 K3 Art. 1	Gartner, Stefan. Coccoliths and Related Calcareous Nannofossils from Upper Cretaceous Deposits of Texas and Arkansas.
QE 701 K3 Art. 57	Lamb, James L., and Beard, John H. Late Neogene Planktonic Foraminifers in the Caribbean, Gulf of Mexico, and Italian Stratotypes.
QE 701 K3 Art. 62	Stainforth, R. M., Lamb, J. L., Luterbacher, H., Beard, J. H., and Jeffords, R. M., 1975. Cenozoic Planktonic Foraminiferal Zonation and Characteristics of Index Forms and Appendix (2 vols.).
QE 711.2 R37 1978	Raup, David M. and Stanley, Steven M. Principles of Paleontology.
QE 719 I57	Haq, Bilal U., and Boersma, Anne, eds. Introduction to Marine Micropaleontology.
QE 719 M52	Funnell, B. M., and Riedel, W. R., eds. The Micropaleontology of Oceans: Proceedings of the symposium held in Cambridge 10-17 September, 1976 ("Micropaleontology of Marine Bottom Sediments").
QE 719 N36 1984	Haq, Bilal U. Nannofossil Biostratigraphy.
QE 719 023	Ramsay, Anthony T. S., ed., Oceanic Micropalaeontology. 2 vols.
QE 719 S83	Swain, Frederick M., ed. Stratigraphic Micropaleontology of the Atlantic Basin and Borderlands.
QE 719 S88	Sliter, William V., ed. Studies in Marine Micropaleontology and Paleoecology: a memorial volume to Orville L. Bandy.
QE 719 T36	Tappan, Helen N. The Paleobiology of Plant Protists.
QE 767 I56 1967	Bronnimann, P., and Renz, H. H., eds. Proceedings of the First International Conference on Planktonic Microfossils (September 27-October 3, 1967, Geneva).

QE 767 M18	Riedel, W. R., and Saito, T., eds. Marine Plankton and Sediments (Third Plankton Conference and Third Symposium on Recent and Fossil Marine Diatoms, 9-13 September, 1974, Kiel).
QE 767 P525 1985	Bolli, Hans M., Saunders, John B., and Perch-Nielsen, Katharina, eds. Plankton Stratigraphy.
QE 770 M35 1974	Majewske, Otto P. Recognition of Invertebrate Fossil Fragments in Rocks and Thin Sections.
QE 770 T7 1979	Moore, Raymond C., Teichert, Curt, and Robinson, Richard A., eds. Treatise on Invertebrate Paleontology.
QE 772 B62 1984	Boersma, Anne. Handbook of Common Tertiary Uvigerina.
QE 772 C34	Ellis, Brooks F. Catalogue of Index Smaller Foraminifera: v. 1 Cretaceous and Paleo Foraminifera, v. 2 Tertiary planktonic Foraminifera, v. 3 Meso-Tertiary benthonic Foraminifera.
QE 772 D46	Curtis, Doris M., ed. Depositional Environments and Paleoecology: Foraminiferal Paleoecology (selected papers reprinted from Journal of Paleontology and Journal of Sedimentary Petrology).
QE 772 E4	Ellis, Brooks F., and Messina, Angelina R. Catalogue of Index Foraminifera: 1. Lepidocyclinids and Miogypsinids, v. 2 Nummulites, Assilina, Orbitolina, Coskinolina..., v. 3 Discocyclinids, orbitoids, Sulcoperculina...
QE 772 F66	Lipps, Jere H. Foraminiferal Ecology and Paleoecology.
QE 772 K4 1983	Kennett, James P., and Srinivasan, M.S. Neogene Planktonic Foraminifera: A Phylogenetic Atlas.
QE 772 M29	Mallory, V. S. Lower Tertiary Biostratigraphy of the California Coast Ranges.
QE 772 M58 1986	Morkhoven, Frank P. C. M. van. Cenozoic Cosmopolitan Deep-water Benthic Foraminifera.
QE 772 M87	Murray, John W., and Wright, Christopher A. Paleogene Foraminiferida and Paleoecology, Hampshire and Paris Basin and the English Channel.
QE 772 P64	Postuma, J. A. Manual of Planktonic Foraminifera.

QE 772 P76	Takayanagi, Y., and Saito, T., eds. Progress in Micropaleontology: selected papers in honor of Prof. Kiyoshi Asano.
QE 772 T7 1983	Tjalsma, R. C., and Lohmann, G. P. Paleocene-Eocene Bathyal and Abyssal Benthic Foraminifera from the Atlantic Ocean.
QE 773 B56 1984	Blome, Charles C. Upper Triassic Radiolaria and Radiolarian Zonation from Western North America.
QE 773 F65	Foreman, H. P., and Riedel, W. R. Catalogue of Polycystine Radiolaria.
QE 773 M68 1984	Petrushevskaia, M. G. and Stepan'iants, S. D. Morphology, Ecology and Evolution of Radiolaria: material from the IV European Radiolarian Symposium, EURORAD-IV, 15-19 October, 1984, Leningrad.
QE 773 N54 1984	Nigrini, Catherine, and Lombari, Gail. A Guide to Miocene Radiolaria.
QE 773 P418	Pessagno, Emile A. Radiolarian Zonation and Stratigraphy of the Upper Cretaceous Portion of the Great Valley Sequence, California Coast Ranges.
QE 773 P48	Pessagno, Emile A. Lower Cretaceous Radiolarian Biostratigraphy of the Great Valley Sequence and Franciscan Complex, California Coast Ranges.
QE 773 S34 1984	Schaff, Andre. Les Radiolares du Cretace Inferieur et Moyen: Biologie, Systematique, Biochronologie et Paleoenvironnement.
QE 955 A92	Aubry, Marie-Pierre. Handbook of Cenozoic Calcareous Nannoplankton (volume 1).
QE 955 C34 1983	Haq, Bilal U. Calcareous Nannoplankton.
QK 569 D54 H9 1985	Hustedt, F. The Diatoms, v. 2: The Pennate Diatoms (in German).
QL 362 B27 1980	Barnes, Robert D. Invertebrate Zoology.
QL 368 F6 A74	Boltovskoy, Esteban, et al. Atlas of Benthic Shelf Foraminifera of the Southwest Atlantic.

QL 368 F6 B613	Boltovskoy, Esteban, and Wright, Ramil. Recent Foraminifera.
QL 368 F6 C15	Buchanan, Hugh. Calculated Distribution of Foraminiferal Wall Structure Types in Sediments of the Great Bahama Bank.
QL 368 F6 C618	Culver, Stephen J., and Buzas, Martin A. Distribution of Recent Benthic Foraminifera in the Gulf of Mexico.
QL 368 F6 C84 1982	Culver, Stephen J., and Buzas, Martin A. Distribution of Recent Benthic Foraminifera in the Caribbean Region.
QL 368 F6 E52 1976	Ellis, Brooks F. (ed. by Saito, T., Hillman, N. S., and Janal, M. J.). Catalogue of Planktonic Foraminifera, v. 1 pt. 1 and v. 2 pt. 2 Neogene; v. 3 pt. 1 and v. 4 pt. 2 Paleogene; v. 5 pt. 1 and v. 6 pt. 2 Mesozoic (reprinted from Catalogue of Foraminifera by Ellis and Messina, 1940).
QL 368 F6 F67	Hedley, Ronald H., and Adams, Charles G., eds. Foraminifera.
QL 368 F6 I61 1983	Oertli, H. J., and Teichel, M., eds. Benthos '83: Second International Symposium on Benthic Foraminifera, Pau (France), 11-15 April, 1983).
QL 368 F6 P43	Frerichs, William E., and Pflum, Charles E. (ed. by Sliter, W. V.). Gulf of Mexico Deep-water Foraminifers.
QL 368 F6 P6	Poag, C. W. Ecologic Atlas of Benthic Foraminifera of the Gulf of Mexico.
QL 368 R2 A5 1983	Anderson, O. R. Radiolaria.
QL 368 R2 N54 1979	Lombari, Gail, and Boden, Gary T. Modern Radiolarian Global Distributions (bound with "A Guide to Modern Radiolaria," by T. C. Moore and C. A. Nigrini).

APPENDIX 5: ZEISS MANUALS AVAILABLE ON BOARD

MICROSCOPES
- Standard and Standard WL Operating Instructions
- Differential Interference Contrast Systems Operating Instructions
- Standard RA Microscope
- Microscopy From the Very Beginning
- Incident-light Photomicroscope III
- Zeiss Transmitted-Light and Incident-Light Polarizing Microscope
- Zeiss Stereomicroscope D, DR, DRC, and DV 4

ILLUMINATORS
- Microscope Illuminator 30 Operating Instructions
- Microscope Illuminator 100 Operating Instructions

ACCESSORIES
- Accessories for Transmitted Light Polarizing Microscopy
- Retardation Plates
- MC63 Photomicrographic Camera for Microscopes and DRC Stereomicroscopes

SPECIFICATIONS
- Light Filters, Camera Systems, Optical Systems for Reflected Light

revised by ODP
October 1987

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=  DEEP SEA DRILLING PROJECT  =
=     PALEONTOLOGY DATA BASE  =
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I. INTRODUCTION

A. BACKGROUND AND METHODS

The Deep Sea Drilling Project (DSDP) paleontologic data base is prepared from data published in the DSDP Initial Reports. The data base contains all of the **Cenozoic paleo data from each Initial Report. Reworked material is not included as part of the data set.

All records within the data base have the same basic format. If multiple physical records are needed to complete a logical record (a complete slide description) then data items leg through page number reference are repeated on successive physical records. The last field stores the physical record number pertaining to each logical record.

Since there may be more than one investigator contributing studies for the same fossil group and leg, each investigator's name appears on the record along with an Initial Report volume number and page reference.

** For data on sediments older than the Cenozoic, contact:

Dr. Pavel Cepek
Bundesanstalt fur Geowissenschaften und Rohstoffe
3 Hannover 51, Postfach 510153
Federal Republic of Germany.

B. LEGS IN DATA SET

The database currently contains data for legs 1-96.

II. FORMAT AND FIELD DESCRIPTIONS

A. DATA FORMAT

FIELD	FORMAT
LEG	I3
SITE	I4
HOLE	A1
CORE	I3
CORE_CHAR	A2
SECTION	A2
TOP INTERVAL (cm)	F5.1
BOTTOM INTERVAL (cm)	F5.1
DEPTH TO CORE (meters)	F8.2
SAMPLE DEPTH (meters)	F8.2
NUMBER OF OBSERVED FOSSILS	I2
INVESTIGATORS NAME(S)	A30
PUBLICATION DATE (month/year)	A5
DSDP INITIAL REPORT VOLUME NUMBER	I2
FOSSIL GROUP CODE	A1
GROUP ABUNDANCE	A1
CHEMICAL OVERGROWTH	I1
CHEMICAL DISSOLUTION	I1
MECHANICAL PRESERVATION	A1
AGE CODE	A8
PAGE NUMBER REFERENCE	A4
FOSSIL CODE 1	A9
FOSSIL ABUNDANCE 1	A2
FOSSIL PRESERVATION 1 (optional)	A2
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.	
.	
FOSSIL CODE 10	A9
FOSSIL ABUNDANCE 10	A2
FOSSIL PRESERVATION 10 (optional)	A2
RECORD JOIN CODE	A1
PHYSICAL RECORD NUMBER	I2

B. FIELD DESCRIPTIONS

The definition of leg, site, hole, core and section may be found in the appended explanatory notes. In addition, the special core designations (CORE_CHAR), as well as the methods of sample labeling and calculating absolute sample depths are discussed.

INTERVAL DEPTH:

The depth in centimeters from the top of the core section.

CORE DEPTH:

The subbottom depth in meters to the top of the core.

SAMPLE DEPTH:

The subbottom depth in meters to the middle of the sample.

CHEMICAL OVERGROWTH:

A measure of the chemical deposition of material on the surface of the fossil(s). It is an integer scale from 0 to 6, where 0 represents no overgrowth, and 6 is maximum overgrowth.

CHEMICAL DISSOLUTION:

A measure of the amount of fossil dissolution which has taken place. It is an integer scale from 0 to 6 where 0 represents no dissolution and 6 maximum dissolution.

MECHANICAL PRESERVATION:

A measure of the physical condition of the fossil(s) in the sample.

G=GOOD M=MODERATE P=POOR

GROUP ABUNDANCE:

Gives the relative abundance of the fossil group using the following scale.

P=PRESENT	**T=TRACE**	**R=RARE**	**F=FEW**
C=COMMON	**A=ABUNDANT**	**D=DOMINANT**	

GROUP CODE:

There are twenty-six (A-Z) fossil group codes. Only twenty-one groups are currently represented.

GROUP CODE		GROUP NAME
A		APTYCHI
B		BENTHIC FORAMS
C		DINOFLAGELLATES
D		DIATOMS
E		CRINOID
F		PLANKTONIC FORAMS
G		ALGAE
H	*	PTEROPOD
I	*	MISCELLANEOUS FOSSILS
J		ARCHAEOMONADS
K		CALCISPHERULIDES
L	*	CALPIONELLIDS
M	*	MOLLUSCS
N		NANNOS
O		OSTRACODES
P		POLLEN AND SPORES
Q		EBRIDIANS & ACTINICIDIANS
R		RADIOLARIA
S		SILICOFLAGELLATES
T		TRACE FOSSILS
U	*	COPROLITHS
V		RHYNCOLLITES
W		AMMONITES
X		PHYTOLITHARIA
Y		FISH DEBRIS
Z		BRYOZOANS

* Not represented in the current data base.

AGE CODE:

The age code is an eight digit integer which represents the age that has been assigned to the interval from which the sample was taken. An age code dictionary is available as a separate file which normally accompanies the paleo data base.

PAGE NUMBER REFERENCE

Indicates the page number or appendix (APP) within the Initial Report from which the information was taken. It may also indicate that the information came from a supplemental (SUPP) publication.

FOSSIL CODE/ABUNDANCE/PRESERVATION GROUP

A thirteen character repeating data field which identifies each fossil and indicates relative abundance and state of preservation. The structure of this group code is outlined

below.

CHARACTER	REPRESENTS
1	FOSSIL CODE: GROUP CODE (A-Z)
2-5	GENUS CODE
6-9	SPECIES NUMBER
10-11	FOSSIL ABUNDANCE
12-13	FOSSIL PRESERVATION (optional)

FOSSIL CODE (characters 1-9): The fossil code contains a group code (A-Z), a 4 letter genus code and a 4 digit species number. There is a fossil code dictionary, available as a separate data file, which lists the codes and the corresponding fossil names. Within the dictionary, any fossil whose name is followed by a parenthetically enclosed Q "(Q)" has a questionable identity. This allows for a fossil whose identity was not certain to be associated with a distinct code.

FOSSIL ABUNDANCE (characters 10-11): Equivalent to the group abundance field described earlier except that numerical percentages (0-99%) may also occur.

FOSSIL PRESERVATION (characters 12-13): If a letter is encoded (G,M,P) it represents the level of mechanical preservation mentioned earlier. If an integer is encoded the information is related either to chemical dissolution (-6 to 0) or chemical overgrowth (0 to +6) as described earlier.

RECORD JOIN CODE:

Indicates the treatment of duplicate source records. In most cases data from duplicate records represents data from the same slide examination which was displayed in different parts of the Initial Report. These records are joined with all data assigned to the page number representing the major source. An encoded "P" indicates that the logical record contains two or more observations of the same slide, eg. a range chart entry and a plate reference. An "I" code indicates the data manager felt the observations should remain independent.

FOSSIL CODE DICTIONARY FILE

The fossil code dictionary is an auxillary file which contains all of the fossil codes and their corresponding names. This dictionary is required to interpret the fossil codes used within the DSDP paleo data base. In order to accomodate instances where fossil identification is in question, there will be two codes for the same fossil. One code is used when a postive identification was made and the other whenever the identification was questionable. If the identification was questionable the fossil name is followed by a parenthetically enclosed Q "(Q)".

DICTIONARY FORMAT

FIELD	FORMAT
DICTIONARY FOSSIL CODE	A9
DICTIONARY FOSSIL NAME	A70

DICTIONARY FOSSIL CODE:

The dictionary fossil code coincides with the nine character fossil code described earlier in this document (see FOSSIL CODE/ABUNDANCE/PRESERVATION).

CHARACTER	REPRESENTS
1	GROUP CODE
2-5	GENUS CODE
6-9	SPECIES NUMBER

DICTIONARY FOSSIL NAME:

The complete fossil name. A fossil name followed by a parenthetically enclosed Q "(Q)" denotes instances when identification was questionable. Spelling of the names were recorded as they appeared in the Initial Reports. When conflicts in spelling did occur we attempted to resolve them by consulting with a paleontologist in the appropriate field. In cases where conflicts were not resolved, both names are included and both should be searched for if the user believes they are the same species. Occasionally, two numbers may appear for the same fossil. the user should be aware that both codes should be searched for to insure finding all occurrences of that particular species.

revised by ODP
October 1987

DEEP SEA DRILLING PROJECT
AGEPROFILE

I. INTRODUCTION

A. BACKGROUND

The AGEPROFILE presents age assignments for each DSDP hole as determined by investigators. The term "section" refers to an AGE section not a core section. The data has been selected from one of three sources: the Initial Reports (the blue books), the Initial Core Descriptions or the shipboard site summaries.

B. LEGS IN DATA SET

The database contains age assignments for legs 1-96. The assigned ages are updated with the publication of each Initial Report.

II. FORMAT AND FIELD DESCRIPTIONS

A. DATA FORMAT

FIELD	FORMAT
LEG	I3
SITE	I4
HOLE	A1
AGE MNEMONIC	A6
AUXILIARY AGE MNEMONIC	A6
TOP OF SECTION DEPTH (meters)	F6.1
BOTTOM OF SECTION DEPTH (meters)	F6.1
SPECIAL CONDITION FLAG ("I","*")	A1
AGE CODE	I8
AUXILIARY AGE CODE	I8
AVERAGED AGE CODE	I8
AGE TOP OF SECTION (million years)	A5
AGE BOTTOM OF SEC. (million years)	A5
AVERAGE AGE (million years)	A5

DATA SOURCE ("IR","ICD","SITESUM") A7

B. FIELD DESCRIPTIONS

The definition of leg, site, hole, core and section may be found in the appended explanatory notes. In addition, the special core designations (CORE_CHAR), as well as the methods of sample labeling and calculating absolute sample depths are discussed.

AGE MNEMONIC:

An abbreviation of the age name. An auxiliary age is also encoded when it is not possible to determine the precise age for the section. This field is often empty. If two ages are noted, it should not be inferred that they represent ages of the top and bottom of the section. The meaning of a dual assignment is that a precise age determination cannot be made and the age of the section is somewhere in that range.

SECTION DEPTH:

The subbottom depth in meters to either the top or bottom of the AGE section.

SPECIAL CONDITION FLAG:

I = A legitimate age inversion
* = Missing hole or drilled interval

AGE CODE:

The age code is an eight digit integer which represents a specific geological age. An age code dictionary is available as a separate file and normally accompanies this data base.

AGE:

The assigned age in millions of years that were calculated by one investigator and are not to be considered official DSDP values. They are included for user convenience only. Values were determined for the top and bottom of each section range and their average.

DATA SOURCE:

IR = DSDP Initial Reports
ICD = Initial core descriptions
SITESUM = Hole summaries