



# Activity of the Month

## *Activity of the Month – September, 2008* It's "Sedimentary," My Dear Watson

### Summary

In this introductory activity, students will analyze core sample data to identify sediment composition on the ocean floor. During this process they will map localities using latitude and longitude, locate and access core sample images from Google Earth to make their own qualitative observations, and analyze then plot sediment data. Class members then combine their findings to gain a better understanding of the types of sediments on the ocean floor.

### Learning Objectives

Students will be able to:

- Use Google Earth to locate sites on a world map
- Locate a position on a map given longitude and latitude
- Describe core samples
- Analyze core sample data
- Calculate ratios/proportions

### National Science Standards

Standard A – Science as Inquiry

Standard B – Physical Science

Standard C – Life Science

Standard D – Earth and Space Science

Standard E – Science and Technology

### National Geographic Standards

Standard 1 – Using Maps

Standard 10 – Characteristics, distributions, and complexity of Earth's cultural mosaics

Standard 16 – Changes that occur in the meaning, use, distribution, and importance of resources.

### National Math Standards

NM-NUM.6-8.1: Understand numbers, ways of representing numbers, relationships among numbers, and number systems

NM-NUM.6-8.2: Understand meanings of operations and how they relate

NM-NUM.6-8.3: Compute fluently and make reasonable estimates

### Target Age: Grades 6-8

Time: 1-2 class periods

### Materials

- Poster-size world map
- Student world map (included here)
- Student Page
- Table 1: Sea Floor Cores Identification Chart
- Table 2: Smear Slide Sample Identification Chart
- Core Thumbnail Images from [www.oceanleadership.org/classroom/sediment\\_cores](http://www.oceanleadership.org/classroom/sediment_cores)
- Colored pencils

### Optional:

- Google Earth loaded onto computer
- Computers with internet access

### Background

Throughout the world's ocean, scientists use scientific drilling to acquire core samples that hold evidence for understanding the past. For scientists to get the most out of a core sample, they need to be able to identify its components - both sediment texture and whether it contains any mineral grains, microfossils, or other rock fragments. With these things identified, scientists can infer age, climate changes, and polarity, among other aspects. Using new technology such as Global Positioning and satellites, students can now locate core drilling sites and use the internet to access scientific data recorded during and after these expeditions. Students can then make their own hypotheses about Earth's history.

If you plan to use Google Earth, load the IODP data into Google Earth before you start:

1. Download and Install Google Earth onto your computer at <http://earth.google.com>
2. Add the IODP web-based program:
  - a. Use Google Earth's top menu to select Add – Network Link.
  - b. Customize the “Name” of the link to be called “Drill Sites.”
  - c. Copy and paste the following link:  
<http://campanian.iodp-mi-sapporo.org/google/data/iodp.kml> into the “Link” field.
  - d. Hit OK.
  - e. Under “Places,” check the named link, Drill Sites, you added to become active.
  - f. Wait 10 to 15 seconds for Google Earth to start loading data.
  - g. When the process is complete, the locations of boreholes drilled during IODP, ODP, DSDP will be shown on the map.

## What to do

1. Give each student a copy of Tables 1 and 2.
2. From the Sea Floor Cores chart have each student select 5 sites. Explain that these are core tops, the most recent sediments laid down.
3. On a student world map, have the students locate and mark each site with an open-circle using the given latitude and longitude.
4. Pass out copies of the core thumbnail images or have students access them online.
5. **Optional:** Use Google Earth to locate each of their 5 selected sites and look at the core samples.
  - a. Click on drilling site.
  - b. Record latitude/longitude.
  - c. Click on core data.
  - d. Look down on list to “core photo images.”
  - e. Complete the Data Request Form with the information from your selected cores from the Smear Slide Sample Identification Chart.
  - f. Click on a core section photo.
  - g. Describe how each one looks on the Student Page in the column labeled “Your Core Description.” Be sure to note at least three important characteristics about your core and note their location in the core.
  - h. Have students predict what the core is made of, based on their observations. For example, if the core is white, they might predict it contains a lot of calcium.
6. Use the Decision Tree and the data given on Table 2 to identify the type of sediments at each of the five sites that they chose. Students should write this information on their sheets.
7. Students then use the key below to color code the sites on their maps accordingly and add a key.
 

Blue – calcareous sediments

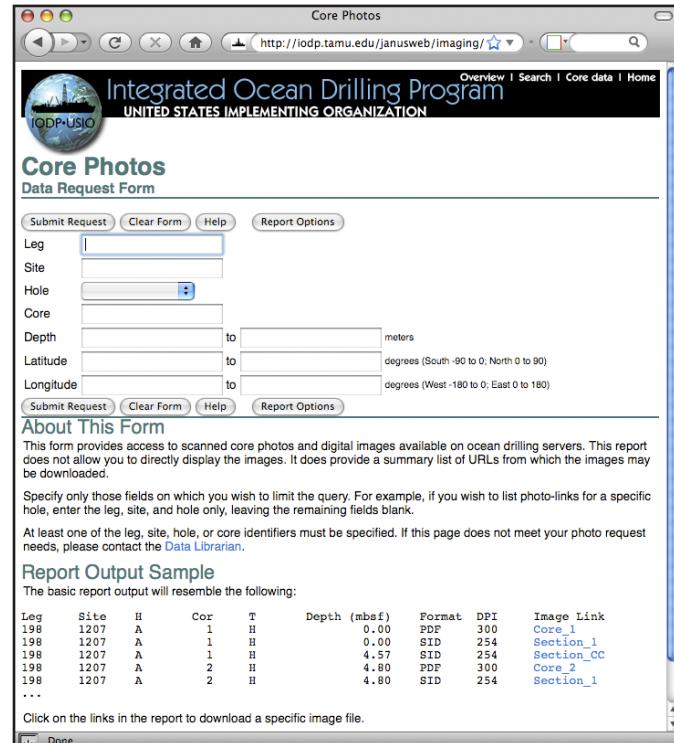
Yellow – siliceous sediments

Red – deep sea clays

Purple – deep terrigenous (from land) sediment

Pink – shallow terrigenous (from land) sediment

Green – glaciomarine (from a glacier) sediment
8. As a class, have the students locate and color-code all 30 sites on the poster map.



## Analysis

Once the poster map is completed, conduct a discussion considering the following:

- What patterns do you see in the locations of different types of sediments?
- What could explain the patterns you see?
- Is there anything that surprises you about the locations and their sediments? Why?
- What do you think the basement rock distribution pattern would be? Would it be patchy (like the sediments)? Why or why not? Encourage students to think about how rock forms versus how sediments form. Help them to realize that basement rock is always going to be youngest at the ridges and oldest away from them.

## Answer Key

Below you will find Rothwell's (1989) Sediment Type Distribution Map. Your students' class map should look similar to this one, at least for the kinds of sediments they found in their locations.

## Extension Activities

### Before starting

Have each student do a word wall entry for the different types of sediments. Have them do a written description, including location, and then do a drawing of them. Post them on the wall so all can be seen while the students are working on the project.

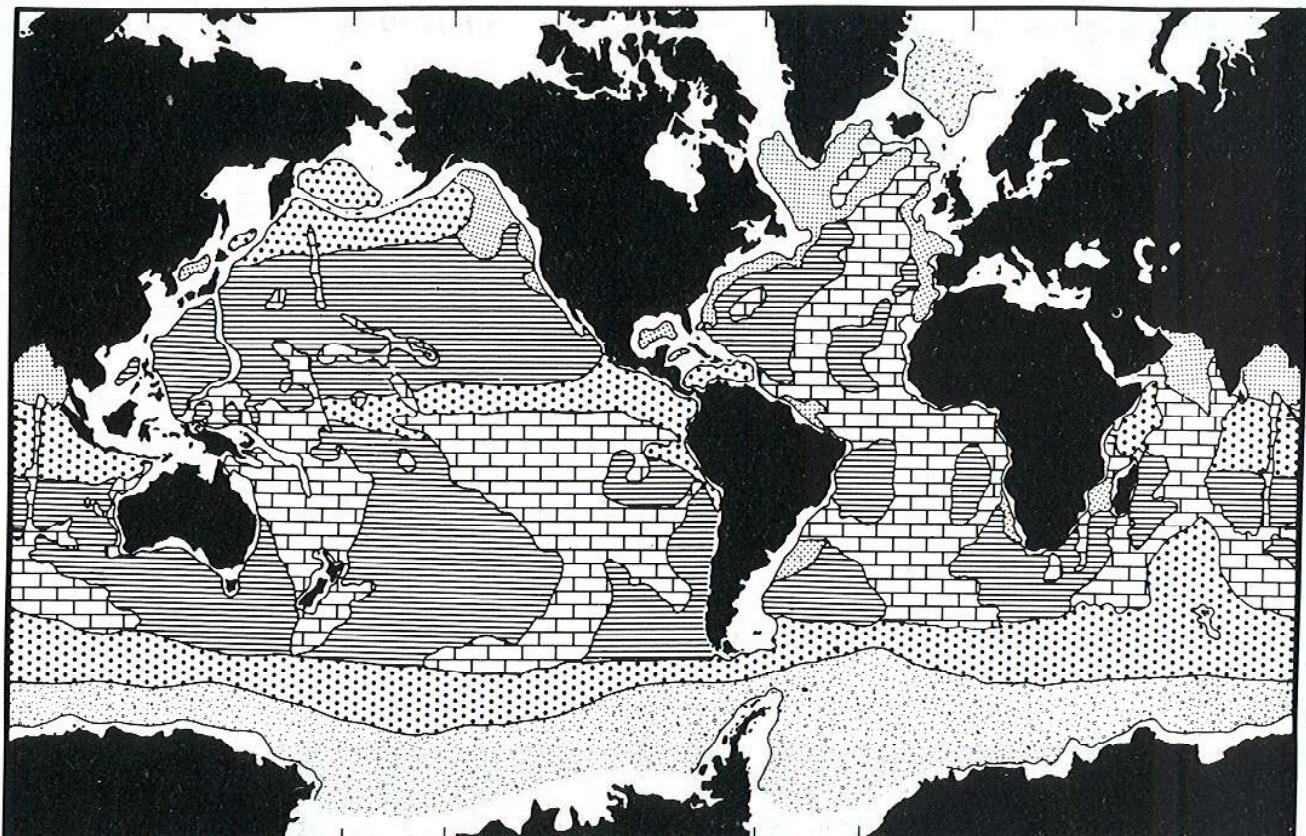
### After Completing

#### Further Questioning:

Are there any relationships between the percent microfossils and the location of the core?

Have the students also record the depth at which the sample was taken and then see if there is a relationship between sediments and depth.

Math Extension - Find distances on map using Pythagorean Theorem or the distance formula, and triangulation or other geometry concepts.



Calcareous sediments



Terrigenous sediments



Glaciogenic sediments



Siliceous sediments



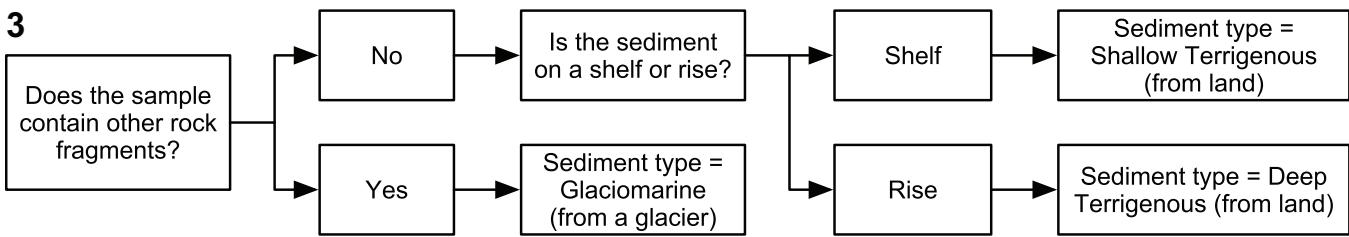
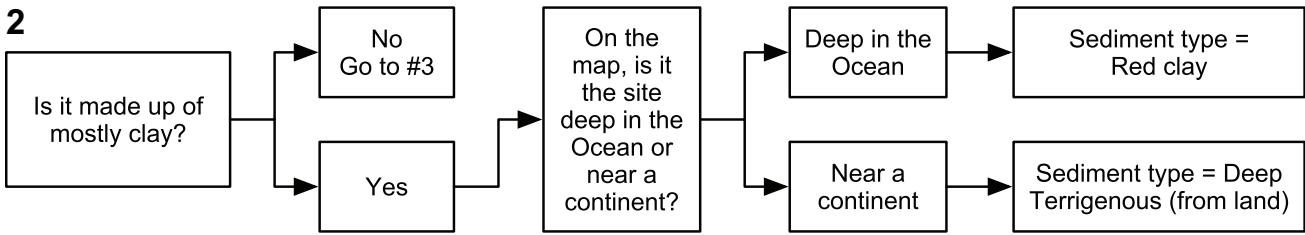
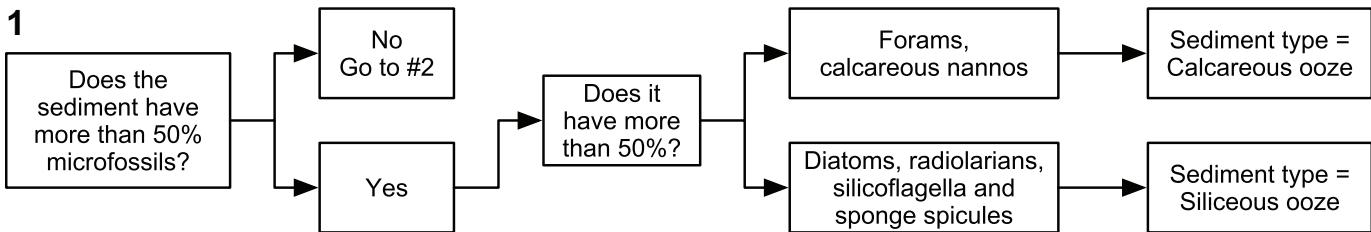
Deep-sea clay



Margin sediments

Activity submitted by: Cathy Hardesty, Hill-Gustat Middle School, Florida, School of Rock 2008 and based on:  
Inquiry Into Sediment Cores, 2008, Kristen St. John and R. Mark Lecke, ([www.oceanleadership.org/classroom/sediment\\_cores](http://www.oceanleadership.org/classroom/sediment_cores))

# Decision Tree



# Student Page

- From your Sea Floor Cores Chart, select 5 sites. These samples are core tops, the most recent sediments laid down.
- On a world map, locate each site using the given latitude and longitude.
- Find each of your core samples on the Core Thumbnail pages your teacher will give you.
  - Describe how each one looks in the column labeled "Your Core Description." Be sure to note at least 3 important characteristics about your core and note their location in the core.
  - What do you think each core is made of?
- Use the Decision Tree sheet and the data given on the Smear Slide Sample Identification Chart to identify the type of sediments at each of the 5 sites you chose.
- Using the color key below, go back and color over the 5 sites that you graphed

Blue – calcareous ooze

Yellow – siliceous ooze

Red – Red clays

Purple – deep terrigenous (from land) sediment

Pink – shallow terrigenous (from land) sediment

Green – glaciomarine (from a glacier) sediment

Leg	Site	H	Cor	T	Depth (mbsf)	Format	DPI	Image Link
198	1207	A	1	H	0.00	PDF	300	Core_1
198	1207	A	1	H	0.00	SID	254	Section_1
198	1207	A	1	H	4.57	SID	254	Section_CC
198	1207	A	2	H	4.80	PDF	300	Core_2
198	1207	A	2	H	4.80	SID	254	Section_1
...								

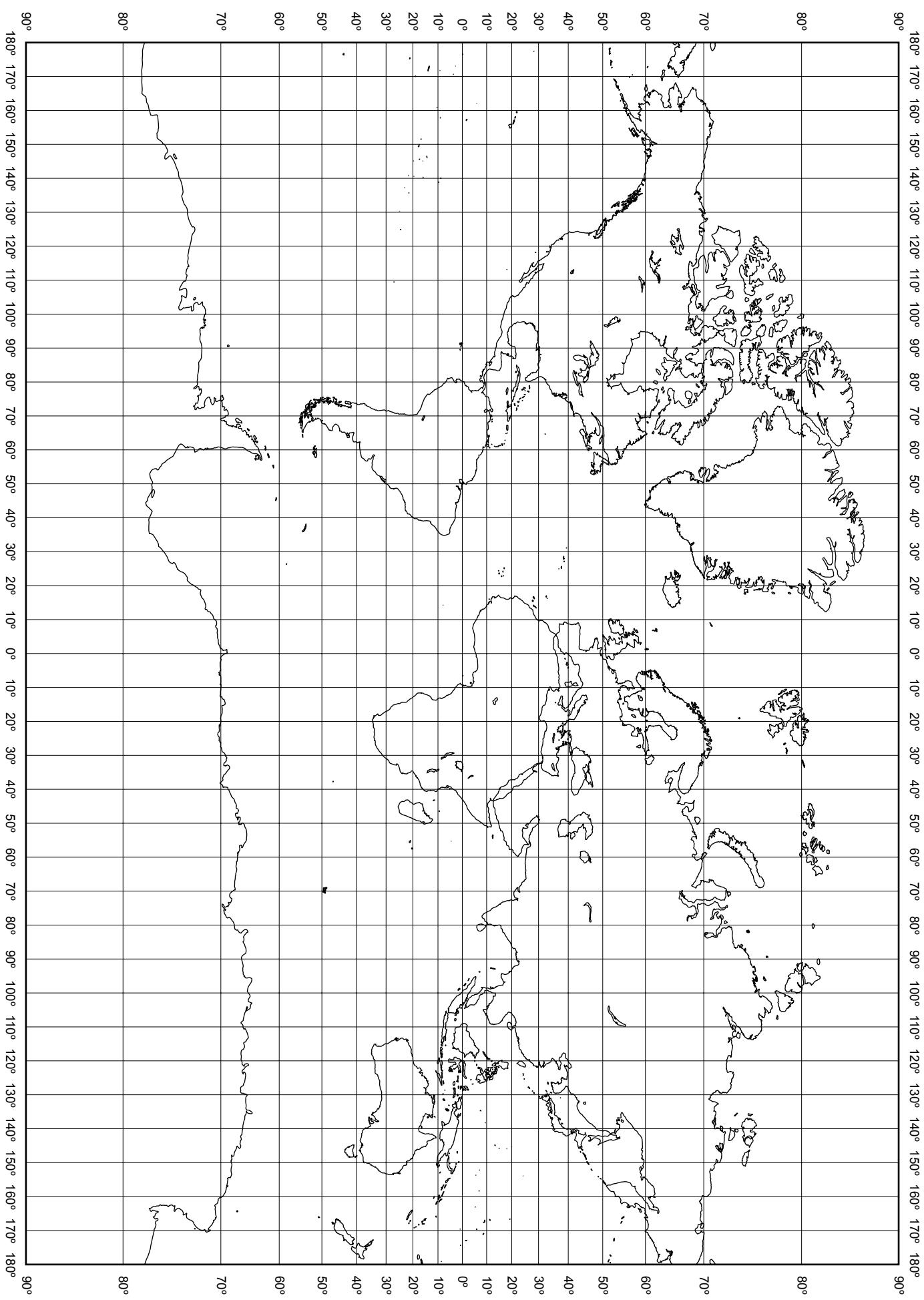
Click on the links in the report to download a specific image file.

**Optional:** Use Google Earth to locate each of your 5 selected sites and look at the core sample.

- Click on drilling site.
- Record latitude/longitude.
- Click on Core Data.
- Look down on list to "Core Photo Images."
- Complete the Data Request Form with the information from your selected cores.
- Click on a core section photo.

## Core Data Chart

Expedition	Latitude/ Longitude	Your core description	Sediment Texture	Mineral Grains %	Microfossils %	Rock Fragments %	Sediment Name



# Table 1. Sea Floor Cores

## Pacific Cores

Core Identification: Exped-Site&Hole-Core&Type	Physiographic Location	Latitude/Longitude	Water Depth (m)	Reference
112-687A-2H	Peru continental shelf	-12.9/-77.0	316	Seuss et al., 1988
35-324-1	SE Pacific basin, north of Antarctica	-69/-98.8	4433	Hollister et al., 1976
28-269-1	Ross Sea, south of Australia, north of Antarctica	-61/7/+140.1	4282	Hayes et al., 1975
145-886B-2H	Chinook Trough, North Pacific abyssal plain	+44.7/-168.2	5743	Rea et al., 1993
145-882A-2H	Detroit Seamount, NW Pacific	+50.36/-167.6	3243.8	Rea et al., 1993
145-881A-1	NW Pacific, East of the Sea of Okhotsk	+47.1/+161.5	5531.1	Rea et al., 1993
145-887C-2H	Patton-Murray Seamount, NE Pacific	+54.4/-148.5	3633.6	Rea et al., 1993
19-188-2	Bering Sea	+53.8/+178.7	2649	Creager et al., 1973
18-182-1	Alaskan continental slope	+57.9/-148.7	1419	Klum et al., 1973
33-318-2	Line Islands Ridge, south central Pacific	-14.8/-146.9	2641	Schlanger et al., 1976
8-75-1	Marquesas Fracture Zone, central Pacific abyssal plain	-12.5/-135.3	4181	Tracey et al., 1971
92-597-1	SE Pacific abyssal plain	-18.8/-129.8	4166	Leinen et al., 1986
178-1101A-2H	Antarctic Peninsula continental rise	-64.4/-70.3	3279.7	Barker et al., 1991
178-1096A-1H	Antarctic Peninsula continental rise	-67.57/-77	3152	Barker et al., 1991
178-1097A-3R	Antarctic Peninsula shelf	-66.4/-70.75	551.7	Barker et al., 1991
29-278-3	south of New Zealand	-56.6/+160.1	3675	Kennett et al., 1974
202-1236A-2H	Nazca Ridge, SE Pacific	-21.4/-81.44	1323.7	Mix et al., 2003
206-1256B-2H	Guatemala Basin	+6.7/-91.9	3634.7	Wilson et al., 2003
8-74-1	Clipperton Fracture Zone, central Pacific abyssal plain	+6.1/-136.1	4431	Tracey et al., 1971
136-842A-1H	south of Hawaii	+19.3/-159.1	4430.2	Dziewonski et al., 1992
198-1209A-2H	Shatsky Rise, NE Pacific	+32.7/+158.5	2387.2	Bralower et al., 2002
199-1215A-2H	NE of Hawaii, North Pacific abyssal plain	+26.0/-147.9	5395.6	Lyle et al., 2002
86-576-2	West of Midway Island, North Pacific abyssal plain	+32.4/+164.3	6217	Heath et al., 1985
195-1201B-2H	Philippine Sea	+19.3/+135.1	5710.2	Salisbury et al., 2002
130-807A-2H	Ontong Java Plateau, western equatorial Pacific	+3.6/+156.6	2803.8	Kroenke et al., 1991
181-1125A-2H	Chatham Rise, east of New Zealand	-42.6/-178.2	1364.6	Carter et al., 1999
169-1037A-1H	Escanaba Trough, west of Oregon, N. California	+41/-127.5	3302.3	Fouquet et al., 1998
146-888B-2H	Cascadia margin, west of Vancouver, WA	+48.2/-126.7	2516.3	Westbrook et al., 1994
167-1010E-1H	west of Baja California	+30/-118.1	3464.7	Lyle et al., 1997
200-1224C-1H	North Pacific abyssal plain, south of the Murray fracture Zone,	+27.9/-142	4967.1	Stephen et al., 2003
127-795A-2H	Japan Sea	+44/+139	3300.2	Tamaki et al., 1990
28-274-2	north of Ross Ice Shelf, Antarctica	-69/+173.4	3305	Hayes et al., 1975

## North Atlantic Cores

Core Identification: Exped-Site&Hole-Core&Type	Physiographic Location	Latitude/Longitude	Water Depth (m)	Reference
37-333-2	western flank of mid-Atlantic ridge	+36.8/-33.7	1666	Aumento et al., 177
82-558-3	western flank of mid-Atlantic ridge	+33.8/-37.3	3754	Bougault et al., 1995
172-1063A-2H	Northeast Bermuda Rise	+33.7/-57.6	4583.5	Keigwin et al., 1998
105-646A-2H	Labrador Sea, south of Greenland	+58.2/-48.4	3440.3	Srivastava et al., 1987
162-980A-2H	Rockall Bank, west of Ireland	+55.5/-14.7	2172.2	Jansen et al., 1996
152-919A-2H	SE Greenland, continental rise	+62.7/-37.5	2088.2	Larsen et al., 1994
174-1073-1H	New Jersey continental shelf	+39.2/-72.3	639.4	Austin et al., 1998
14-137-3H	Madeira abyssal plain	+25.9/-27.1	5361	Hayes et al., 1972

**Table 2. Smear Slide Sample Identification**

Expedition-Site & Hole-Core & Type-Section, Interval (cm)	Sediment Texture (%)		Composition (%)						Sediment Names	Reference												
	Sand	Silt	Mineral Grains			Microfossils		Rock Frags./other														
		Clay	Accessory Min.	Calcite/Dolomite	Clay Minerals	Fe Oxide	Feldspar	Other Minerals*	Mica	Quartz	Volcanic Glass	Calc. Nannos	Diatoms	Foraminifers	Radiolarians	Silicoflagellates	Sponge Spicules	Skeletal Debirs	Carbonate Frags.	Organic matter	Nodules	Rock Fragments
<b>Pacific samples</b>																						
112-687A-2H-1, 79	2	61	37	1	2	37		5		10		2	30	10					2			
112-687A-2H-3, 69		80	20	2	1	19		23	2	35	5									10		
112-687A-2H-5, 61		45	55	10	2	17		5	13	1										37	5	
112-687A-2H-6, 36		25	75	1		75			1	1	20											
35-324-1, 120	none given					40			10		50											
35-324-1, 50	none given					85				10		5										
35-324-1, 100	none given					35	2			3		60										
35-324-1, 100	none given					97		1		2												
28-269-1, 134	none given					5	25			10		55	5									
28-269-1, 37	none given					10			10	1	78	1										
145-881A-1H-1, 50	30	60	10						1	1	98											
145-881A-1H-2, 11	15	40	45			45			10			45										
145-881A-1H-2, 116	40	60							4		94											
145-888B-2H-1, 39	2	10	88			81	2				4	3	10									
145-888B-2H-5, 114	15	10	70			70	2	2	1		4	6	15									
145-888B-2H-6, 16	25	10	65			64	3				5	3	25									
145-882A-2H-2, 58	2		78	20		1				1	1	77										
145-882A-2H-3, 34	2		85	13					1	1	78								20			
145-882A-2H-4, 80	20		75	5					1	2	96	1										
145-887C-2H-1, 75	10		82	8		7				1	72	4	10	6								
145-887C-2H-3, 75	10		45	45		43			1		45	4	2					5				
145-887C-2H-3, 85	3		92	5		5	2	1	92													

\*Other minerals includes opaques, phillipsite, pyroxene, hornblende, and others

D= dominant, A= abundant, C= common, P = present, R= rare, T = trace

Expedition-Site & Hole-Core & Type-Section Interval (cm)	Sediment Texture (%)			Composition (%)							Sediment Names	Reference											
	Sand	Silt	Clay	Mineral Grains			Microfossils		Rock Frags./Other														
				Accessory Min.	Calcite/Dolomite	Clay Minerals	Fe Oxide	Feldspar	Other Minerals*	Mica	Quartz	Volcanic Glass	Calc. Nannos	Diatoms	Foraminifers	Radiolarians	Silicoflagellates	Sponge Spicules	Skeletal Debirs	Carbonate Frags.	Organic matter	Nodules	Rock Fragments
19-1882-1, 56	none given			25	5	5	5	5	5	65													
19-1882-1, 120	none given			10	2	3				85													
19-1882-2, 75	none given			10	5	5				80													
19-1882-2, 75	none given			10	5	5				80													
18-182-1	no smear slide data																						
33-318-2, 67	none given				R					D	A		P	C									
8-75-1, 100	none given			90	9					1													
8-75-1, 3, 10	none given			10						90													
8-75-1, 5, 10	none given			5						94	1												
92-597-1, 1, 35	none given			85		13			2														
92-597-1, 2, 110	none given			10		5			85														
178-1010A-2H-1, 80	1	60	39	1	3	50	8	1	2	15	4	5		2		14						Barker et al., 1991	
178-1010A-2H-2, 60	1	60	39	2	3	31	8	8	3	20	2	2		1								20	
178-1010A-2H-2, 106	90	8	2		1	13	9	4	12		1	40		1								14	
178-1010A-2H-4, 61	1	75	24		5	12	20	4	18		2			1								30	
178-1010A-2H-6, 61		70	30		8	12	13	4	18		10		6									20	
178-1096A-1H-1, 1, 130		30	70		60	5	5				30	1										Barker et al., 1991	
178-1096A-1H-4, 130		20	80		80	5	6	5			1	1											
178-1096A-1H-6, 30	1	25	74		74	10	15			1	1												
178-1097A-3R-1	all gravel																					Barker et al., 1991	
29-278-3-1, 127	none given					15				10	30	10	25	10								Kennett et al., 1974	
29-278-3-CC, 0	none given					2	2			3	75	3	15										
202-1236A-2H-1, 75			100		14					57		25										Mix et al., 2003	
202-1236A-2H, 92					100					R	57	29											
202-1236A-2H, 123					100					R	70	30											
206-258B-2H-2, 113	20	16	64		100					89	9	1	1									Wilson et al., 2003	

\*Other minerals includes opaques, phillipsite, phroxene, hornblende, and others

D= dominant, A= abundant, C= common, P = present, R= rare, T = trace

Expedition-Site & Hole-Core & Type-Section Interval (cm)	Sediment Texture (%)			Composition (%)			Sediment Names	Reference
	Sand	Silt	Clay	Mineral Grains	Microfossils	Rock Frags./Other		
874-1-1, 2	none given							
874-1-5, 10	none given							
138-842A-1H-1, 27	10	50	40	40	17	23		
138-842A-1H-2, 100	5	70	25	1	25	1	5	Tracey et al., 1971
138-842A-1H-4, 90		25	75	1	75	1	5	Dziewowski et al., 1992
138-842A-1H-6, 68	25	60	15	15	20	20	30	
138-842A-1H-6, 130		52	48		18	1	1	
138-842A-1H-7, 20		22	78	1	78	7	2	
138-1209A-2H-1, 139	none given				21		70	Bralower et al., 2002
198-209A-2H-5, 138	none given			1	13		80	
199-1215A-2H-1, 60		100		90	8	2		
199-1215A-2H-3, 100		100		90	9	1		Lyle et al., 2002
199-1215A-2H-CC, 0		100		90	10			
86-57-6-2-1, 7		5	95		85	1	4	Heath et al., 1985
86-57-6-2-2, 80	1	7	92		87	1	6	
86-57-6-2-4, 74	30	68	2		2	1	3	
86-57-6-2-4, 110	1	1	98		94		3	
195-1201B-2H-1, 30		10	90	D	P	R	P	Salisbury et al., 2002
195-1201B-2H-5, 73		5	95	D	R	P	R	
195-1201B-2H-7, 85		10	90	D	P	R	P	
130-070A-2H-2, 74	10	60	30	2		75	2	Kroenieke et al., 1991
181-1125A-2H-1, 49	25	30	45	P	R		D	Carter et al., 1999
169-1037A-1H-3, 80	C	A	R	A	R	C	R	Fouquet et al., 1998
169-1037A-1H-5, 62	A	C	R	R	R	C	A	
146-888B-2H-5, 99	70	25	5		5	25	2	
146-888B-2H-6, 145		75	25		25	20	30	Westbrook et al., 1994

\*Other minerals includes opaques, phillipsite, phroxene, hornblende, and others

D= dominant, A= abundant, C = common, P = present, R= rare, T = trace

Expedition-Site & Hole-Core & Type-Section Interval (cm)	Sediment Texture (%)			Composition (%)								Sediment Names	Reference											
	Sand	Silt	Clay	Mineral Grains				Microfossils								Rock Frags./Other								
				Accessory Min.	Calcite/Dolomite	Clay Minerals	Fe Oxide	Feldspar	Other Minerals*	Mica	Quartz	Volcanic Glass	Calc. Nannos	Diatoms	Foraminifers	Radiolarians	Silicoflagellates	Sponge Spicules	Skeletal Debirs	Carbonate Frags.	Organic matter	Nodules	Rock Fragments	
167-1010E-1H-3, 143	5	15	80	80	2	1			9		3					1								
167-1010E-1H-4, 110		10	90	80					2	10							5							
200-1224C-1H-1, 70		10	90			90											10							
200-1224C-1H-2, 2			5	95		95											5							
200-1224C-1H-3, 70		20	80			65											30	5						
200-1224C-1H-5, 1			25	75		50											45	5						
127-795A-2H-1, 84		10	90	2	60	5			10	15	2					1	1	1						
127-795A-2H-2, 146		40	60		30					10	60													
127-795A-2H-3, 45		60	40		20	15			15	45	1													
127-795A-2H-5, 81		40	60	60	10		20	10																
28-274-2, 109	2	33	65	1	55	11	10		15		6						2							
28-274-2, 86			25	75		60			1	1	35	1					2							
28-274-2, 90			20	80	1	70			4	1	8					1								

\*Other minerals includes opaques, phillipsite, phroxene, hornblende, and others

D= dominant, A= abundant, C= common, P= present, R= rare, T= trace

Expedition-Site & Hole-Core & Type-Section Interval (cm)	Sediment Texture (%)			Composition (%)			Sediment Names	Reference
	Sand	Silt	Clay	Mineral Grains	Microfossils	Rock Frags./Other		
<b>North Atlantic samples</b>								
37-333-32-1, 80	5	24	71			96	4	
82-558-3-3, 75	none given			2	9		87	2
82-558-3-6, 75	none given			5	9		84	2
172-1063A-2H-3, 62		40	60	R	D	T	A	C
172-1063A-2H-6, 66		25	75	R	D	T	C	A
105-646A-2H-1, 60	5	60	35	35	30		35	
105-646A-2H-2, 87	5	85	10	5	10	10	5	65
105-646A-2H-5, 33	10	55	35	15	25	5	35	3
162-980A-2H-1, 90	20	30	50	2	8		1	11
162-980A-2H-3, 80	10	40	50		50		5	10
162-980A-2H-6, 80	10	60	30	5	25	15	3	20
152-919A-2H-1, 76	3	81	16		16	7	2	40
152-919A-2H-3, 18			85	15			2	69
152-919A-2H-4, 50		62	38		6	2	25	5
174-1073-1H-1, 10	none given			2	23	14	2	20
174-1073-1H-1, 120	none given			2	1	39	12	4
14-137-2H-2, 90	none given				81	4	5	2

\*Other minerals includes opaques, phillipsite, phroxene, hornblende, and others

D= dominant, A= abundant, C= common, P= present, R= rare, T = trace