Analyzing Earth's Climate History Using Sediment Cores

STUDENT NAME: .....

STUDENT ACTIVITY

SCIENTIFIC OCEAN DRILLING

Objective(s)/Outcome(s)

Students will be able to analyze data from cores taken from the seafloor to describe patterns in climate fluctuations throughout Earth's history.

Materials

- tape
- colored pencils or highlighter

Background

Watch the video showing the **process of core sample drilling on the Joides Resolution.**

Describing the geology of the cores collected from beneath the seafloor is one of the most important tasks that is completed during the coring process. For expeditions that are conducting research in areas with softer sediment, this task is the responsibility of the sedimentologists on board. The sedimentologists prepare visual core descriptions of all cores containing sediments and sedimentary rocks.

Activity

Part 1

1. Observe an image of a core section.

2. Record observations in your Visual Core Description Report worksheet.

   a. In the Description column of the Visual Core Description Report, describe the colors, textures, and any other physical features of the core sample.

   b. Report the location of each feature by recording the distance from the top in centimeters. For example, "texture looks rough with many deep pockets between 16 and 25 cm."

Part 2

1. Determine which team of sedimentologists you will be working with by matching the Expedition information listed on the right side of your Visual Core Description Report with the corresponding Drillhole Location Map found at each workstation. Take your Visual Core Description Report with you and sit together with your sedimentology team.

2. Each member of your sedimentology team has 1 of the 4 pieces of a single core section taken from the drillhole shown on your Drillhole Location Map. Look for the piece number printed in the far-right column of your Visual Core Description Report handout.

   a. Place the four Visual Core Description Reports in numerical order, starting with Piece #1 at the top and ending with Piece #4 at the bottom.

   b. Fold the top and bottom margins of the handouts to allow each piece of the core section to connect without any gaps in between and tape them together. Your team should now have a complete core section image containing all four pieces.

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3. Label the top depth and bottom depth of the core. Label the oldest and the youngest ends of the core.

4. Use the map given for your expedition (leg) to label the very top of the core with the ocean in which your core was taken.

5. Discuss the visual core descriptions recorded in the Description column with the other sedimentologists on your team, adding any details necessary to accurately describe the cores.

6. Hang up your core sample next to the core samples of all other groups and compare them.

Analysis

1. Compare your core sample to the core samples from the other teams.

   a. What patterns and features do you notice?

   b. Similarities?

   c. Differences?

2. Based on your observations, create a list of questions about your core sample.

3. As a team, select one of your questions and propose a hypothesis that answers your question.

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Synthesis

Background on the Paleocene-Eocene Thermal Maximum (PETM)

The PETM was a period of extreme global warming and ocean acidification that occurred around 56 million years ago (Stephens, 2022). Evidence for the PETM event can be seen in seafloor sediments and was first discovered in cores recovered during Ocean Drilling Program (ODP). Shells of tiny ocean creatures normally collect on the ocean floor when they die, making the sediment mostly white. During the PETM, which was one of the warmest time periods ever recorded, the ocean became more acidic from all of the carbon dioxide in the water. The high acidity in the ocean dissolved the shells of the dead ocean creatures before they could accumulate on the bottom of the sea floor. The lack of shells in the ocean sediment resulted in a dark layer of reddish-brown clay on the ocean floor.

1. Based on this information about the Paleocene-Eocene Thermal Maximum (PETM), identify the section of your sample core that you predict best correlates with this time period in geologic history. Mark this section of your sample core with a highlighter. Be sure to indicate where you predict the **beginning** of the PETM occurred.

2. Compare the location of the PETM shown in your core sample to the core samples from the other teams. Why do you think the location of the PETM varies in different core samples?

3. The PETM is considered to be an ancient analog to modern climate change, which means that scientists see many similarities between these two events. How could studying the geologic record from the PETM be helpful in understanding modern climate change? Explain.

Extensions

1. Predict the effect of the PETM on marine organism biodiversity. Explain your reasoning.

2. Research the relationship between the PETM and ocean acidification. Create a model that shows this relationship.

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3. Revisit questions that were raised at the beginning of the lesson. Which questions were not yet addressed? What information would you need to answer these questions?

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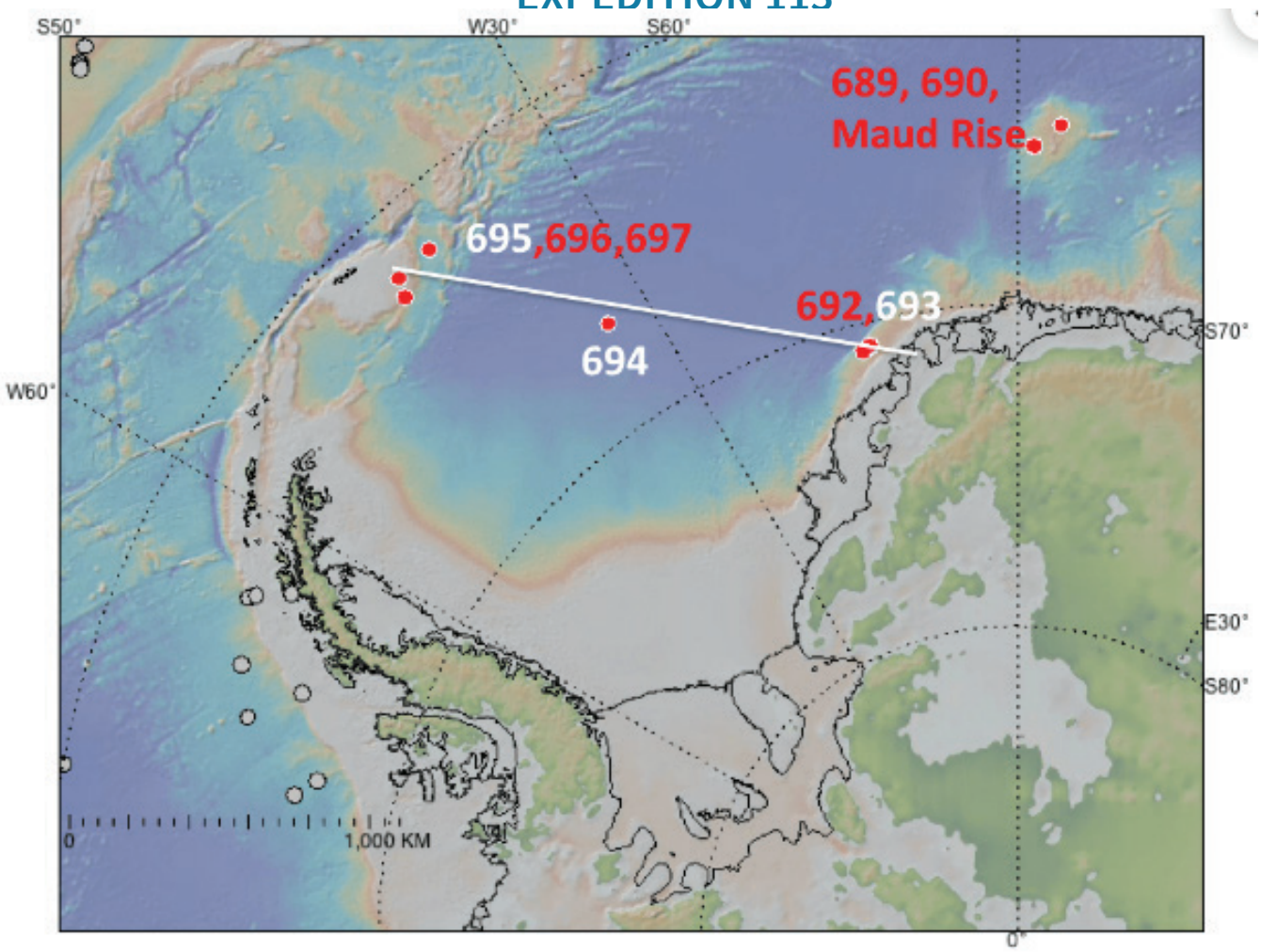
HANDOUTS

EXPEDITION 113



Drillhole Location Map: Expedition 113, Hole 690B 19H Section
Modified from Dr. Suzanne O'Connell, **https://keckgeology.org/2013/11/antarctic-pliocene-and-lower-pleistocene-gelasian-paleoclimate-reconstructed-from-ocean-drilling-program-weddell-sea-cores/**

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Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
113	690	B	20H	2	

Core Image

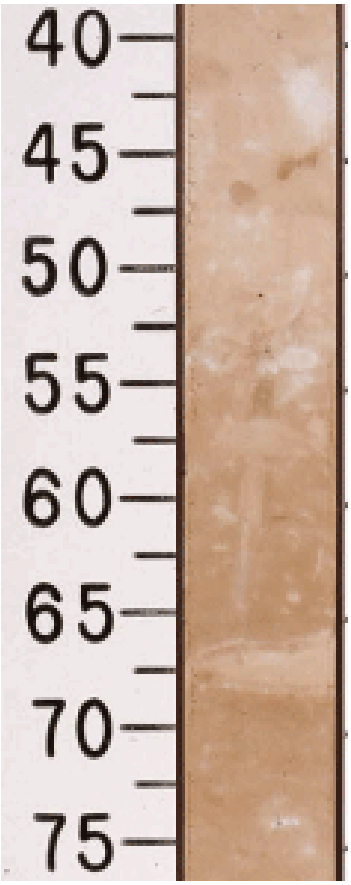
Core Section Image	Description

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
113	690	B	20H	2	

Core Image

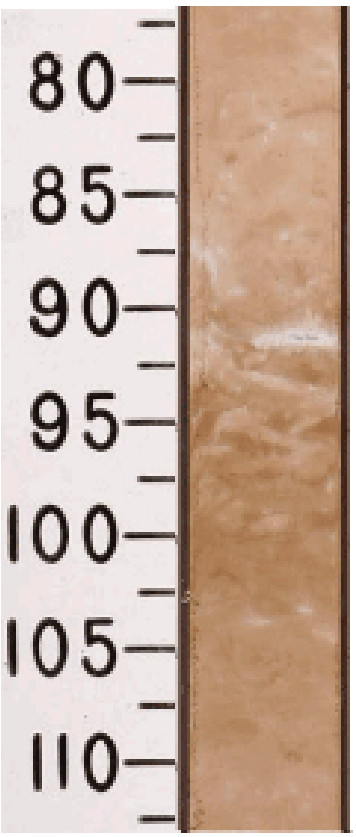
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
113	690	B	20H	2	

Core Image

Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

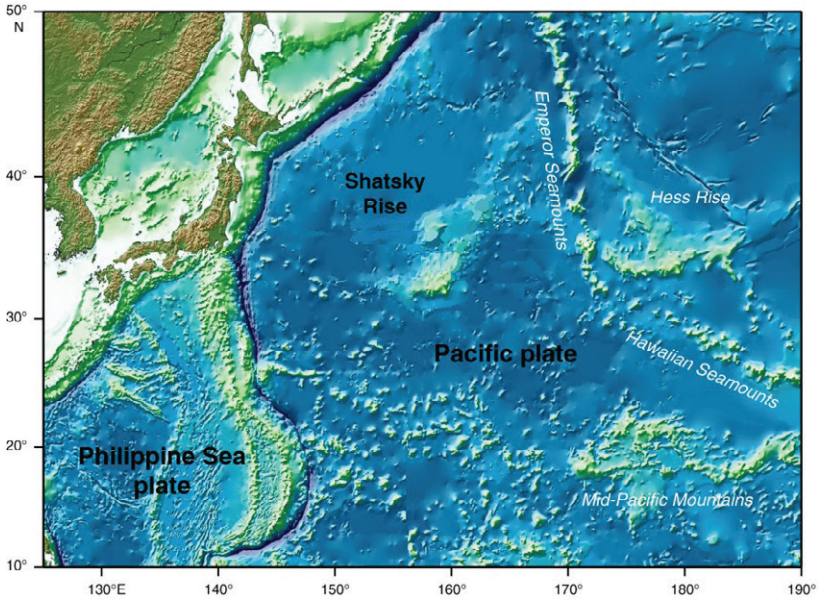
LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
113	690	B	20H	2	

Core Image

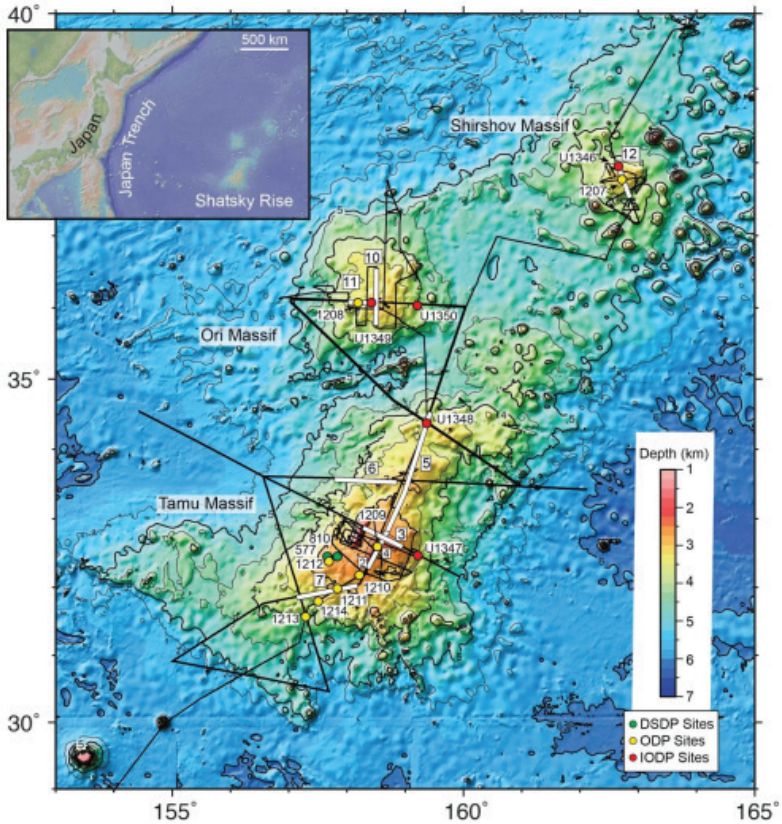
Core Section Image	Description

STUDENT NAME: .....

EXPEDITION 198



Shatsky Rise Map, **http://publications.iodp.org/preliminary_report/324/324_f1.htm**



Drillhole Location Map: Expedition 198, Hole 1210B 20H
Modified fromClark, Sager, and Zhang **https://www.sciencedirect.com/science/article/abs/pii/S0025322716303978**

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Drill Site Log

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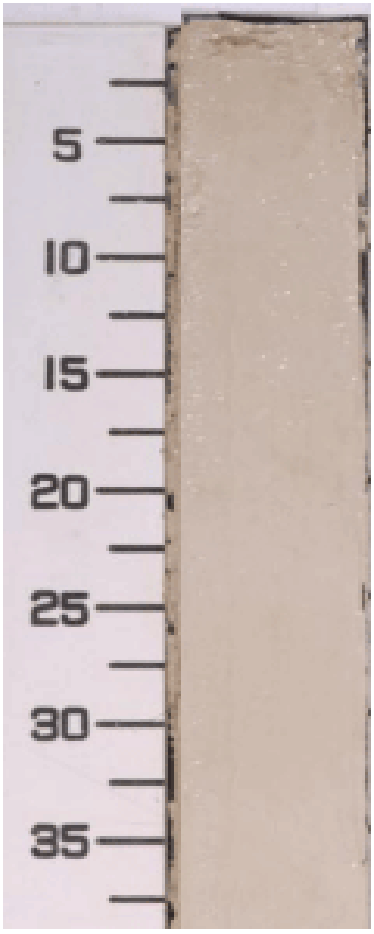
Core Image

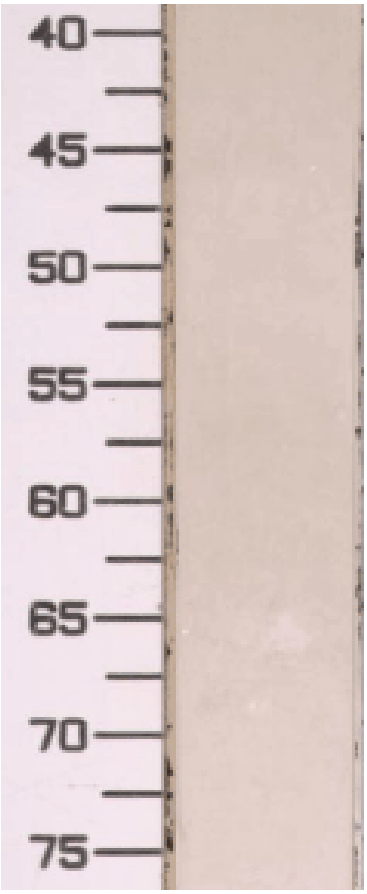
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
198	1210	B	20H	3	

Core Image

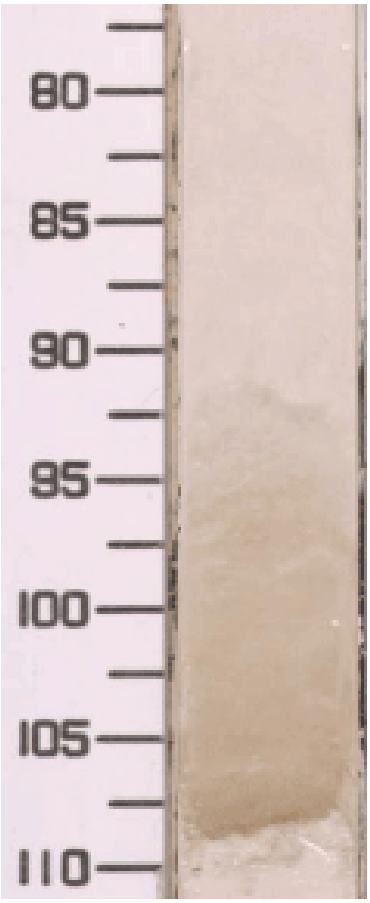
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
198	1210	B	20H	3	

Core Image

Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

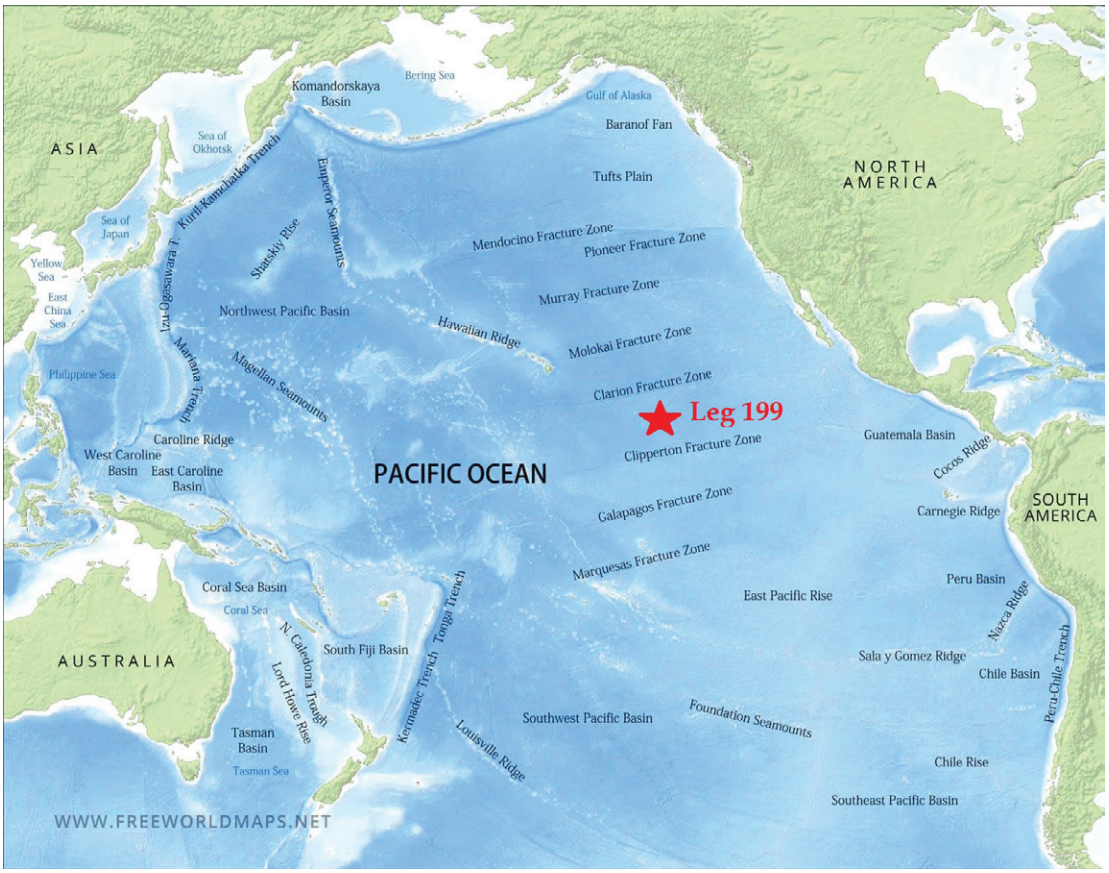
LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
198	1210	B	20H	3	

Core Image

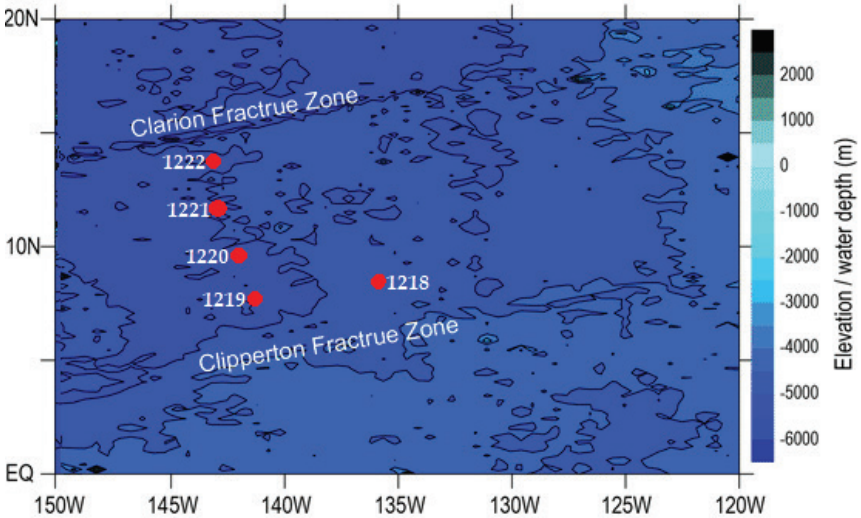
Core Section Image	Description

STUDENT NAME: .....

EXPEDITION 199



Modified from: **https://www.freeworldmaps.net/ocean/pacific/pacific-landforms-map.jpg**



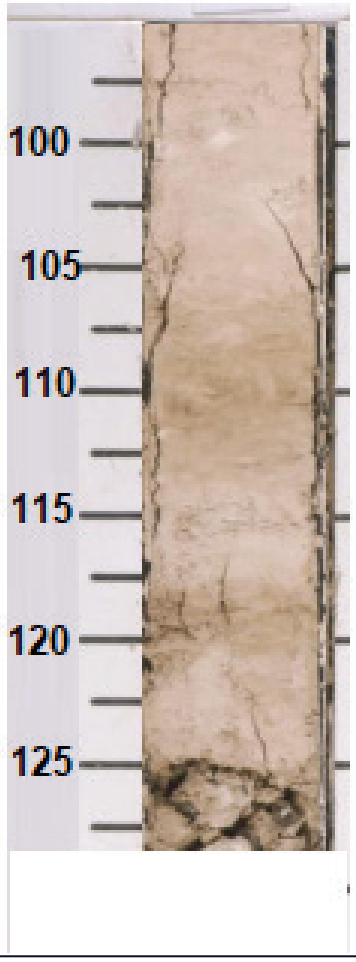
Drillhole Location Map: Expedition 199, Hole 1220B 20X Section
Modified from**https://www.frontiersin.org/articles/10.3389/fmars.2021.636305/full**

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
199	1220	B	20X	1	

Core Image

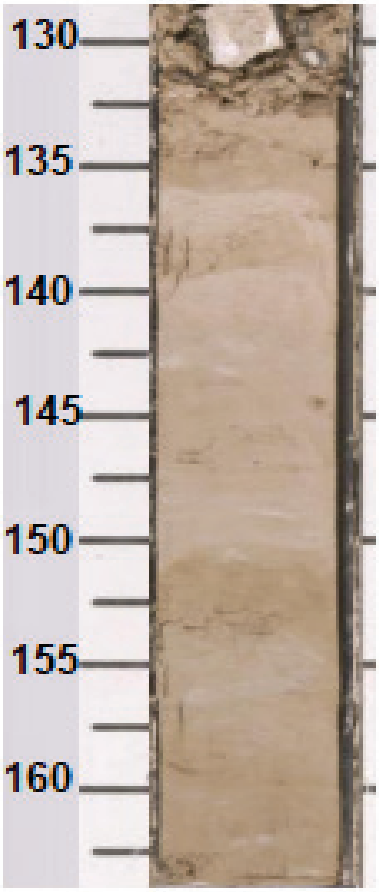
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
199	1220	B	20X	1	

Core Image

Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
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Core Image

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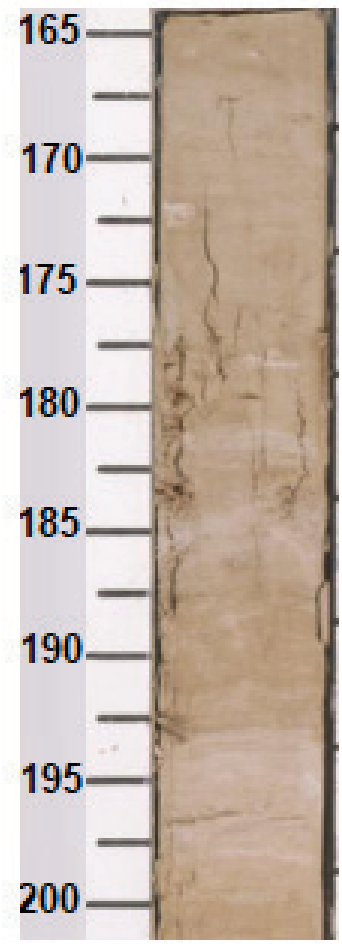
	

STUDENT NAME: .....

Drill Site Log

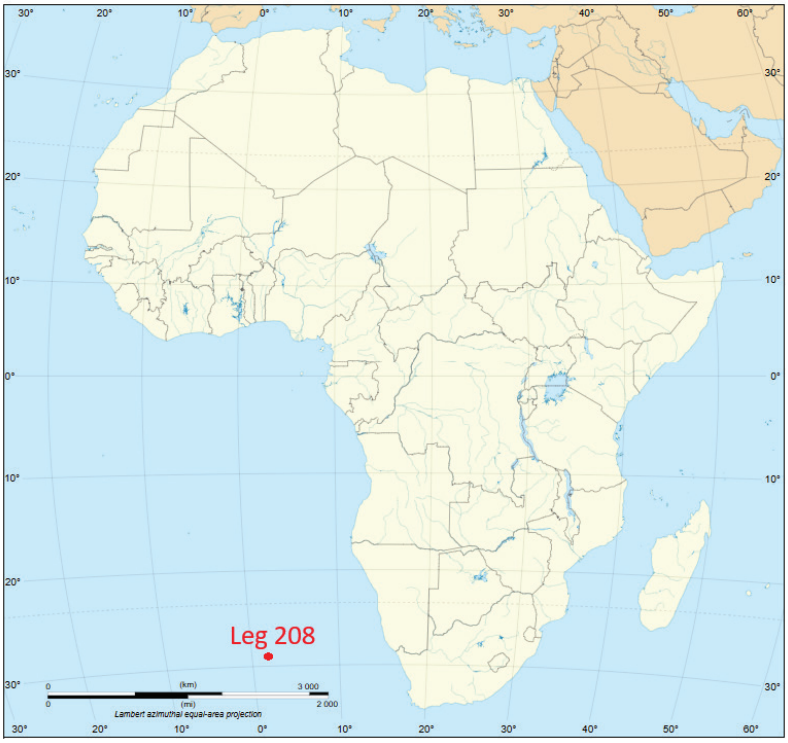
LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
199	1220	B	20X	1	

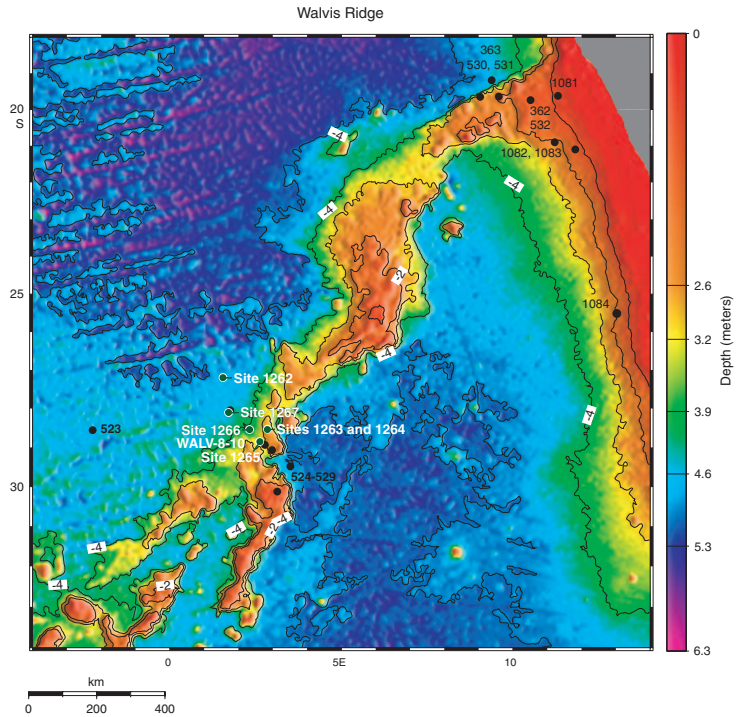
Core Image

Core Section Image	Description

STUDENT NAME: .....

EXPEDITION 208





ODP Leg 208 Site Map

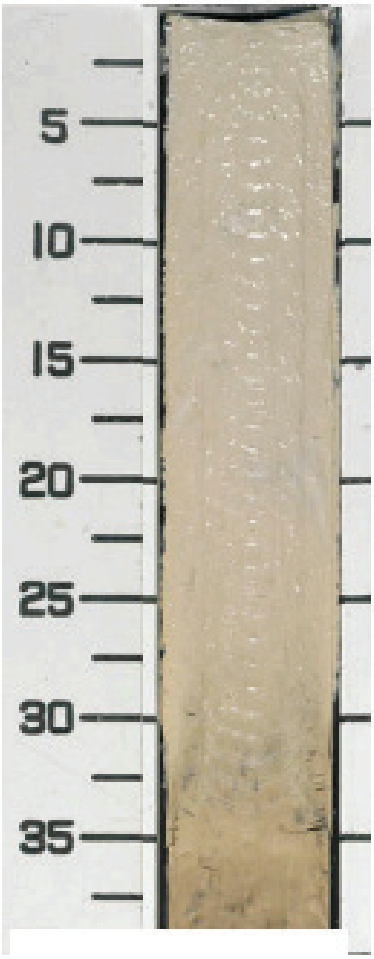
Drillhole Location Map: Expedition 208, Hole 1262B 15H Section 3 - Walvis Ridge SE Atlantic
Credit: Xue et al, 2022

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
208	1262	B	15H	3	

Core Image

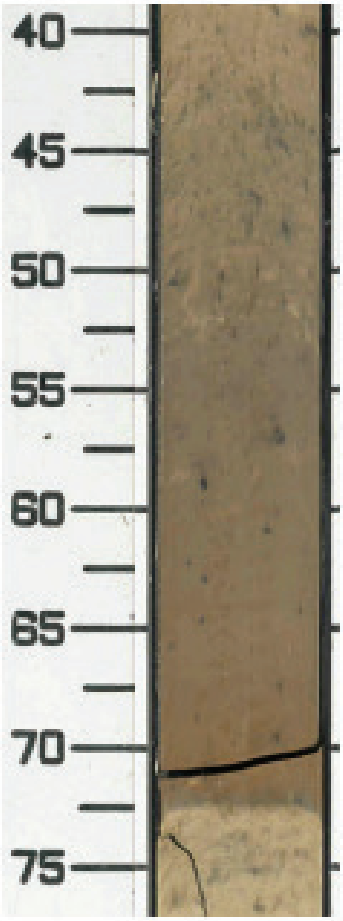
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
208	1262	B	15H	3	

Core Image

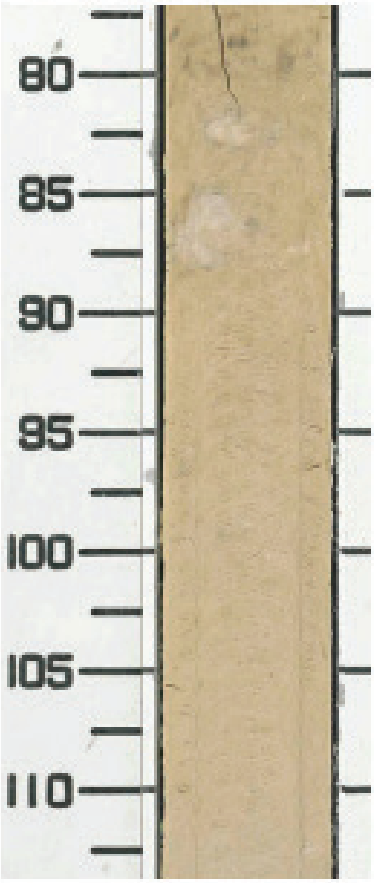
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
208	1262	B	15H	3	

Core Image

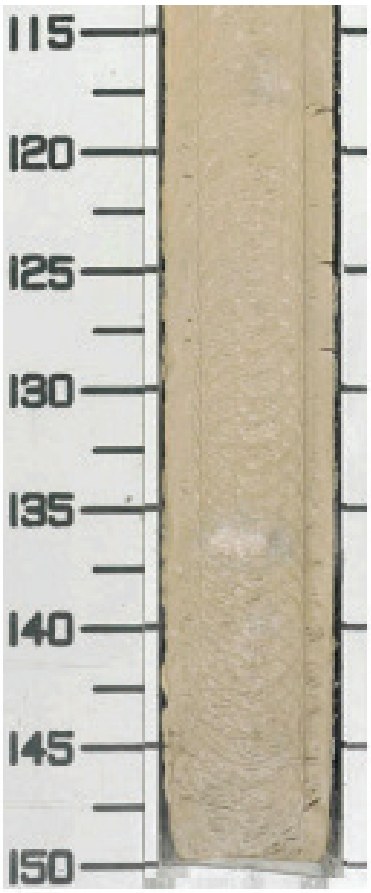
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

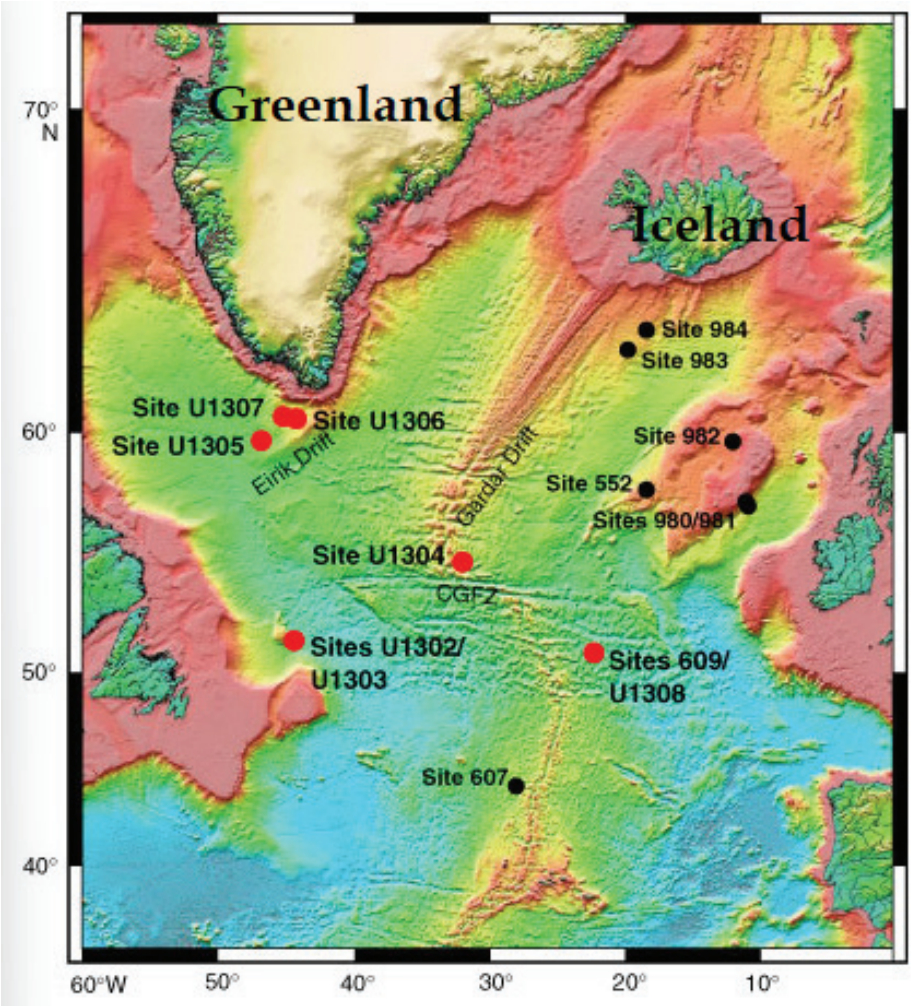
LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
208	1262	B	15H	3	

Core Image

Core Section Image	Description
	

STUDENT NAME: .....

EXPEDITION 303



Water depth key (in order from shallowest to deepest waters):

Pink
Orange
Yellow
Green
Light Blue
Darker Blues

Drillhole Location Map: Expedition 303, Hole 1308A 6H Section
Modified from **http://publications.iodp.org/proceedings/303_306/101/101_f1.htm**

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Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
303	1308	A	6H	1	

Core Image

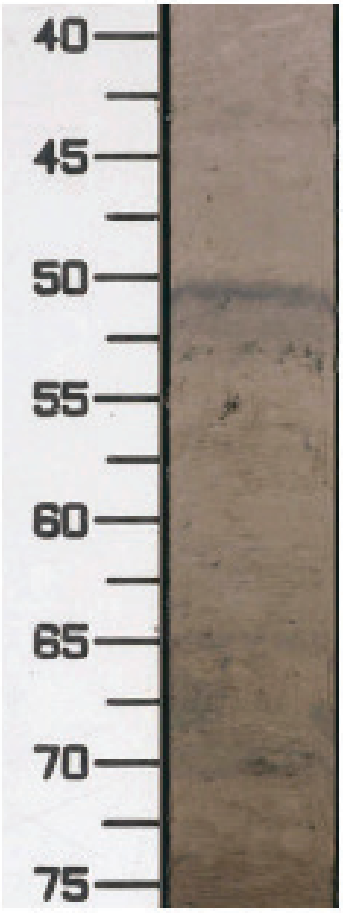
Core Section Image	Description

STUDENT NAME: .....

DRILL SITE LOG

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
303	1308	A	6H	1	

CORE IMAGE

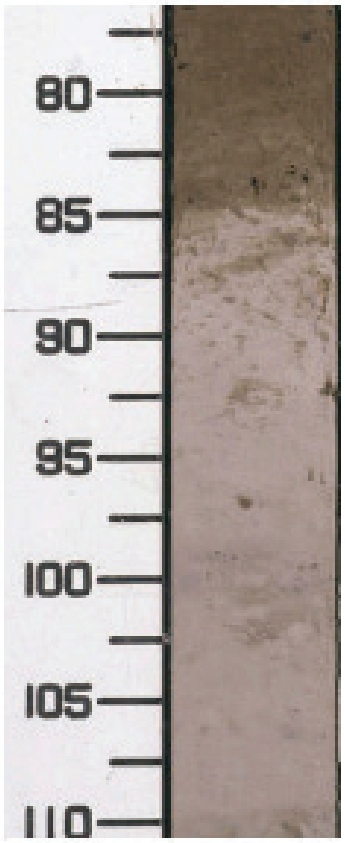
Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
303	1308	A	6H	1	

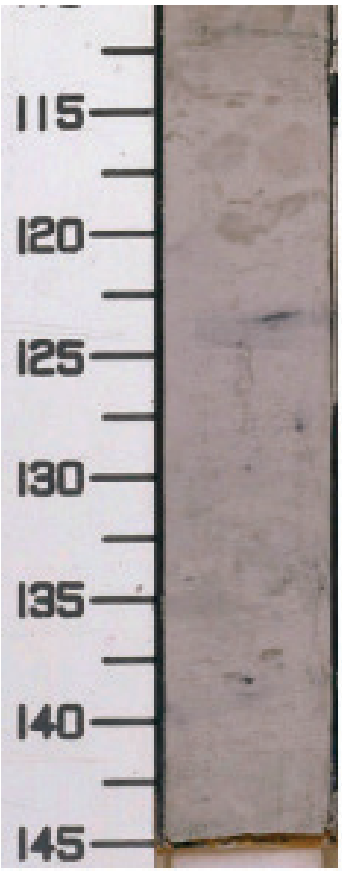
Core Image

Core Section Image	Description
	

STUDENT NAME: .....

Drill Site Log

LEG	SITE	HOLE	CORE	SECTION(S)	OBSERVER
303	1308	A	6H	1	

Core Image

Core Section Image	Description