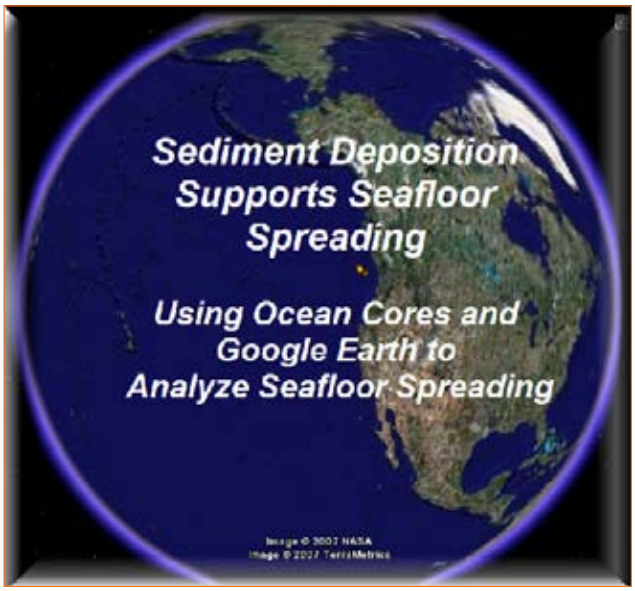
Sediment Deposition Supports Seafloor Spreading - Teacher's Guide

Using Ocean Cores to Analyze Seafloor Spreading

Introduction

Tell your students they are going on an expedition to explore changes in the seafloor. Explain that data were collected using sound waves, or sonar and ocean cores. Students may be surprised to learn that the bathymetry data coupled with sediment thickness provides further evidence for seafloor spreading. Throughout the discussion emphasize to students that they, just as the scientists in 1996, are collecting data and trying to determine their significance. This lesson is designed to be implemented in one to two 50 minute class periods. You may choose to order the DVD "The New *JOIDES Resolution* in Film" to spur the discussion. This DVD presents five short films that introduce scientific ocean drilling, take you out on the *JOIDES Resolution* research drilling vessel, and explain the science done at sea. To request a DVD go to *http://www.oceanleadership.org/education/deep-earth-academy/resources/order-form*.



Learning Objectives

Students will be able to:

1. Evaluate sonar and core data collected by the Ocean Drilling Program (ODP) that support seafloor spreading.
2. Use the data to create a graph showing the relationship between distance from the spreading center, depth to the ocean floor, and thickness of the sediments.
3. Explain a historical perspective of science research.

Target Age: Grades 5-12

Time: One class period

National Science Education Standards

Standard A: Science as Inquiry – Abilities necessary to do science inquiry

Standard D: Earth and Space Science – Earth's history

Ocean Literacy Essential Principles

1. Earth has one big ocean with many features
2. The ocean and life in the ocean shape the features of Earth
7. The ocean is largely unexplored.

Lesson Versions and Necessary Items

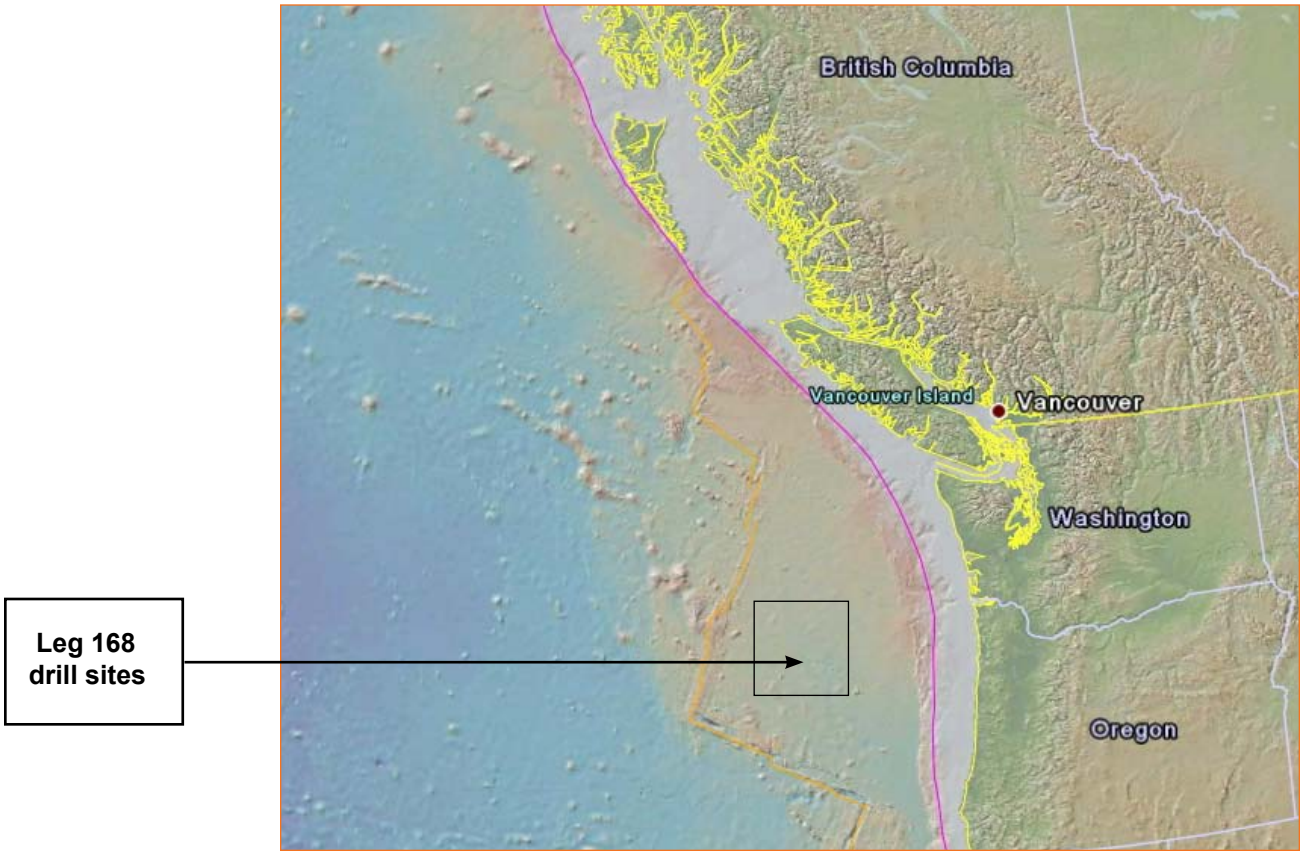
This lesson comes in two forms: a paper based analysis version that requires only the materials listed in the student guide, and a technology based version that requires the use of Google Earth. The activity may be downloaded from *www.oceanleadership.org/education/deep-earth-academy/educators/classroom-activities/sediment-deposition-supports-seafloor-spreading/*.

Google Earth requirements:

1. Download the latest version of Google Earth from *http://earth.google.com/earth*.
2. In order to implement this lesson you must also download the Google Overlay file (*www.oceanleadership.org/wp-content/uploads/2010/01/seafloor_spreading.kmz*) from the Deep Earth Academy Web site. We recommend placing this file on the desktop of each computer for easy access during the lesson. To open the kmz file, open Google first and then select the File > Open menu.
3. The images are generally current to within the past three years. The Google Earth view of the ocean is digitally created so you can see the "look of the seafloor" without water. Of course, a real satellite picture of the ocean would show water.

Student Activity

You may choose to put students in groups of two so that one student is in charge of reading directions and writing answers while the other navigates the computer; this works especially well for mixed reading levels. In addition to the instructions, the student pages help students zero in on key concepts. We recommend printing class sets of the student guide in color to best show the screen shots. However, each student or student pair will need the answer pages, which may be printed in black and white.



Conclusion

Students should understand methods for collecting bathymetric data and uses of these data. Additionally, students should conclude that the ODP expedition provided additional evidence for the theory of seafloor spreading. As students compare sediment thickness and distances from the Juan De Fuca Ridge they conclude that the seafloor is spreading along the ridge axis.

Answer Key

Data Collection

ODP Expedition 168 Site	Velocity of Sound in Water (m/s)	Sonar Travel Time (s)	Depth to Ocean Floor (m)	Sediment Thickness (m)	Depth to Basalt (m)	Distance East of Ridge (km)
Spreading center	1500	2.80	2100	0	2100	0
1023	1500	3.51	2633	315	2948	22
1024	1500	3.53	2648	342	2990	27
1025	1500	3.55	2663	268	2931	34
1030/1031	1500	3.54	2655	194	2849	41
1028	1500	3.65	2738	139	2877	46
1029	1500	3.65	2738	259	2997	56
1032	1500	3.65	2738	416	3154	76
1026	1500	3.67	2753	324	3077	99
1027	1500	3.67	2753	537	3290	102

Analysis

1. Assuming a constant rate of sedimentation throughout the study area, what would cause sediment to be thinner near the Juan De Fuca Ridge and thicker as you move away?

   Near the Juan De Fuca Ridge the sediment has not had very long to accumulate because the basement rocks are young. As you move away from the Juan De Fuca Ridge the sediment becomes thicker because it has had more time to accumulate.

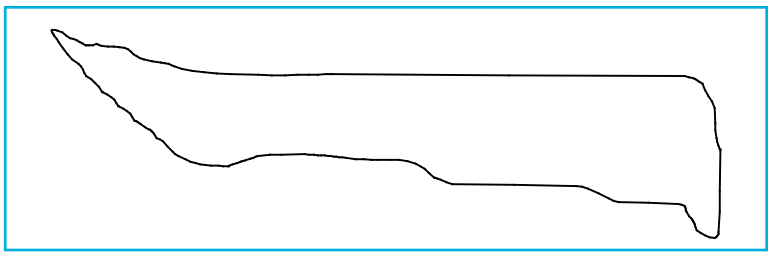
2. Circle the area where the oldest sediments are. Why did you choose this location?

   Because this area is the farthest from the Juan De Fuca Ridge where the basement rocks are the oldest and the sediments at the bottom were deposited long ago. See circle on graph.

3. Where do you think the newest crust is? Where is the oldest crust? Why?

   The newest crust is near the Juan De Fuca Ridge; the crust gets older as you move away from the spreading center. New crust is formed at the spreading center as magma comes up from below. It then slowly moves away from the spreading center.

4. Draw a diagram that shows how the depth of the ooze changes as you travel east across the study area. Describe the shape of the ooze. How does the shape of the ooze support the theory of seafloor spreading?



   (The shape of the ooze supports the theory of seafloor spreading because it is thin near the spreading center and thickens as you move away.)

Answer Page

5. Draw a bold arrow beneath the graph showing the direction the ocean floor is moving.
6. Is this map a true representation of the ocean floor? Why or why not?
   Yes or No. Just be logical.
   No: The samples are not continuous and the vertical and horizontal scales are not the same.
   Yes: The data are real so the representation is real.

Graph