



U.S. Department of Commerce  
National Oceanic & Atmospheric Administration  
National Marine Fisheries Service

# Lesson 15: Sediments

## Overview

This lesson provides an overview of the types of sediments in the ocean including their origin and composition. Common classification methods by size and origin are presented and then students are encouraged to think about how sediments of various types are distributed throughout the ocean. In this activity, students analyze the distribution of sediment throughout the ocean.

## Lesson Objectives

Students will:

1. Identify the origins of different types of sediment
2. Define a deep sea sediment known as “ooze” and differentiate types of ooze based on composition
3. Analyze and describe the distribution of sediment types throughout the ocean

## Lesson Contents

1. Teaching Lesson 15
  - a. Introduction
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2. Student Handout
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## **Standards Addressed**

**National Science Education Standards, Grades 9-12**  
*Unifying concepts and processes*  
*Physical science*  
*Earth and space science*

**Ocean Literacy Principles**  
*The ocean and life in the ocean shape the features of the Earth*

**DCPS, High School Earth Science**  
*ES1.17. Construct and interpret a simple scale map and topographic cross section*

## Lesson Outline<sup>1</sup>

### I. Introduction

Introduce the lesson by asking students to brainstorm a definition of sediment. Ask the students to describe their ideas of what constitutes sediment and how it might get into the ocean. As students identify different potential origins of sediment (e.g., land, organisms), let them know that scientists classify sediment based on these different origins.

Next, create a simple model of sedimentation in the ocean using in the ocean using a type of candy that can easily break apart such as M&M© candies in a clear container with a lid. Assign a different color of M&M to represent each sediment type by origin: lithogenous (sediment from Earth), biogenous (sediment from broken down organisms), hydrogenous (sediment from chemical reactions in seawater) and cosmogenous (sediment from space). Ask students to place candy into the bowl in the proportions that they might expect in reality (e.g., if they expect ocean sediment to be comprised of mostly lithogenous sediment, most of the candy they place in the bowl should represent this sediment type). Once they have placed candy in the bowl in the proportions they think are correct, shake the bowl to simulate forces like waves and currents in the ocean. Students should notice that the candy pieces break apart and mix together, representing sediment in the ocean.

Ask the students whether this is a perfect model to describe sedimentation processes. In particular, ask them whether they think sediment types would be randomly distributed throughout the ocean the way the candy colors are in the bowl. Students might suggest the following:

- Sediments might cluster together based on their location of origin (e.g., sediment from land might tend to stay near coasts).
- Likewise, different coasts might have different rates of sedimentation, leading to different distribution around the globe.
- Sediments might be of different sizes, unlike the candy, which could influence how they move through the ocean.

Today's lesson teaches students about the composition of different sediment types, as well as the distribution of sediments across the ocean.

### II. Lecture Notes

Use the PowerPoint for Lesson 15 (File:Lesson 15 – Sediments.ppt) to present the following information.

*Sediments are important to ocean scientists (slide 2)*

1. Sediment is particulate matter that can be transported by physical processes and eventually deposited.

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<sup>1</sup> Unless otherwise indicated, all websites provided or referenced in this guide were last accessed in November 2010.

2. Scientists study sediments in the ocean to learn about marine ecosystems and to understand the history of the ocean.

*How are sediments classified? (slides 3 - 7)*

1. The Wentworth Scale classifies sediment by grain size. Clay sediments are the smallest with a grain diameter of less than .004 mm and boulders are the largest with grain diameters of 256 mm or larger.
2. Sediments are also classified by origin. There are four types: lithogenous, hydrogenous, biogenous and cosmogenous.  
**Lithogenous sediments** come from land via rivers, ice, wind and other processes.  
**Biogenous sediments** come from organisms like plankton when their exoskeletons break down.  
**Hydrogenous sediments** come from chemical reactions in the water.  
**Cosmogenous sediments** come from space, filtering in through the atmosphere or carried to Earth on meteorites.

*Do you think sediment is uniformly distributed throughout the ocean? (slides 8 – 10)*

1. Sediment is not distributed uniformly throughout the ocean.
2. Lithogenous sediment tends to dominate near the edges of continents and islands due to heavy contributions from land-based sediment sources relative to other sediment sources. Examples of land-based sediment sources include erosion of land and river transportation of sediment to the sea.
3. Biogenous sediment may often dominate in deeper ocean areas because the relative contributions of other sediment sources are less in comparison to the biological-based sediment sources.
4. Biogenous sediments also commonly occur in near shore areas, and biogenous sediments can actually predominate in many shallow areas of tropical oceans. For example, some tropical beaches and coastal areas are covered by a white sand mostly composed of the bodies of a dead benthic macroalgae called Halimeda.
5. **Ooze** refers to deep-ocean sediment that is comprised of more than 30% biogenic material.
  - **Calcareous ooze** is comprised mostly of plankton with calcium carbonate skeletons.
  - **Siliceous ooze** is comprised mostly of plankton with silicon-based skeletons.
6. Hydrogenous sediments make up only a small portion (less than 1%) of ocean sediments.
7. Cosmogenous sediments are the least abundant of all sediment types.

*Sediment thickness in the deep ocean (slides 11 – 13)*

1. Sediment thickness varies throughout the ocean.
2. Sediment thickness in the Atlantic Ocean floor is about twice that of the Pacific Ocean floor. One reason is that rivers flowing into the Atlantic cover more land and bring more sediment than those flowing into the Pacific.

**III. Additional Resources**

1. Sediment classification:  
<http://www.guilford.edu/geology/marseds.html>

**IV. Student Activity**

The activity for this lesson and an answer key are included in the Lesson 15 folder (Files: Sediment Activity.pdf and Sediment Activity Answer Key.pdf) and used with permission by The Bridge ([www.marine-ed.org/bridge](http://www.marine-ed.org/bridge)).

An alternative lesson in which students examine photos of different sediment types is included in the Lesson 15 folder (File: Sediment\_Alt.pdf). This lesson is named “Mud is mud...or is it?” and can also be found at NOAA’s Ocean Explorer website: [www.oceanexplorer.noaa.gov](http://www.oceanexplorer.noaa.gov).

## Tips for the Bowl – Sediments

### Know your terms

Write down definitions and notes for the following terms from your teacher’s presentation:

Erosion:

Ooze:

Calcareous ooze:

Siliceous ooze:

### Know the origin of sediment

Write down the origin of the different types of sediment listed below:

Biogenous:

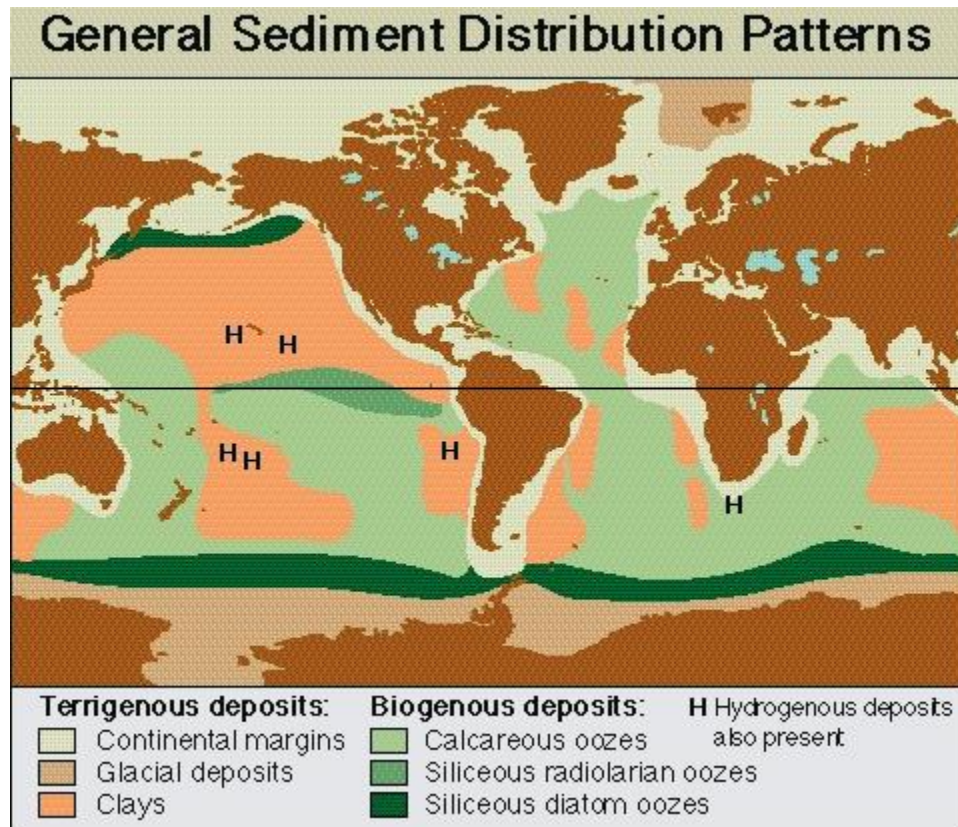
Cosmogenous:

Hydrogenous:

Lithogenous:

### Know the distribution<sup>2</sup>

Learn the distribution of the types of sediment throughout the ocean



<sup>2</sup> Photo used with permission by The Bridge.

## Sediments

1. Reminder question: Which of the following features *does not form* as a result of divergent plate movement?
  - w. Islands
  - x. Mid-ocean ridges
  - y. Rift valleys
  - z. **Trenches**
2. Sediment particles eroded from continental rocks are called...
  - w. Cosmogenous
  - x. Biogenous
  - y. **Lithogenous**
  - z. Hydrogenous
3. Tektites are examples of which type of sediment?
  - w. **Cosmogenous**
  - x. Biogenous
  - y. Lithogenous
  - z. Hydrogenous
4. Short answer: Sediment that is comprised of more than 30% of the broken down shells of organisms is known as what?  
**Answer: Ooze**
5. Which of the following is true regarding sediment flow into the Atlantic and Pacific Oceans?
  - w. Rivers carry more sediment into the Pacific Ocean compared to the Atlantic Ocean
  - x. **Rivers carry more sediment into the Atlantic Ocean compared to the Pacific Ocean**
  - y. Rivers carry about the same amounts of sediment into both oceans
  - z. Rivers are not typically a source of sediment in either ocean
6. Short answer: Sediment near continents and islands is typically mostly made of which type?  
**Answer: Lithogenous**
7. Which of the following sediment types has the smallest grain size?
  - w. **Clay**
  - x. Silt
  - y. Sand
  - z. Granule

8. Which of the following is true of hydrogenous sediments:
  - w. They tend to form rather quickly
  - x. They usually comprise more than half of the sediment on the sea floor
  - y. **They can form near hydrothermal vents**
  - z. They come from space
  
9. This sediment type is the least prevalent on the ocean seafloor:
  - w. Biogenous sediment
  - x. Hydrogenous sediment
  - y. Lithogenous sediment
  - z. **Cosmogenous sediment**

10. Team Challenge Question

1. Describe two ways marine sediment may be classified. (2pt)
  
2. The Wentworth Scale classifies sediment by what characteristic? (1pt)
  
3. List the origins and an example of each of the following four types of sediment: (8pt)
  - a. Lithogenous:
    - Source:
    - Example:
  
  - b. Biogenous
    - Source:
    - Example:
  
  - c. Hydrogenous
    - Source:
    - Example:
  
  - d. Cosmogenous
    - Source:
    - Example:
  
4. What is an ooze? (1pt)
  
5. List one example of an ooze: (1pt)



ANSWER

1. Describe two ways marine sediment may be classified.

**Origin and size**

2. The Wentworth Scale classifies sediment by what characteristic?

**Grain size**

3. List the origins and an example of each of the following four types of sediment (2pt each):

a. Lithogenous:

- Source: **Land**
- Example: **Answers may vary. Some possible responses: clay, quartz, granite**

b. Biogenous

- Source: **Organisms**
- Example: **Answers may vary. Some possible responses: shells, plankton exoskeletons**

c. Hydrogenous:

- Source: **Chemical reactions**
- Example: **Answers may vary. Some possible responses: ferromanganese or phosphite nodules**

d. Cosmogenous

- Source: **Outer Space**
- Example: **Answers may vary. Possible response: microtektites**

4. What is an ooze?

**Sediment in the deep ocean that is composed of 30% or greater biogenous material**

5. List one example of an ooze:

**Calcareous or Siliceous ooze**