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Table of Contents

Objectives

- **Name** the major divisions of the global ocean.
- **Describe** how oceanographers study the ocean.
- **Explain** how sonar works.

End Of Slide

The Water Planet

global ocean the body of salt water that covers nearly three-fourths of Earth's surface

- The global ocean contains more than 97% of all of the water on Earth.
- Although the ocean is the most prominent feature of Earth's surface, the ocean is only about 1/4,000 of Earth's total mass and only 1/800 of Earth's total volume.

End Of Slide

Divisions of the Global Ocean

- The global ocean is divided into five major oceans. These major oceans are the Atlantic, Pacific, Indian, Arctic, and Southern Oceans.
- The Pacific Ocean is the largest ocean on Earth's surface. The next largest ocean is the Atlantic Ocean.
- The Indian Ocean is the third-largest ocean and has an average depth of 3.09 km. The Arctic Ocean is the smallest ocean, and it surrounds the North Pole.

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Resources

Divisions of the Global Ocean, *continued*

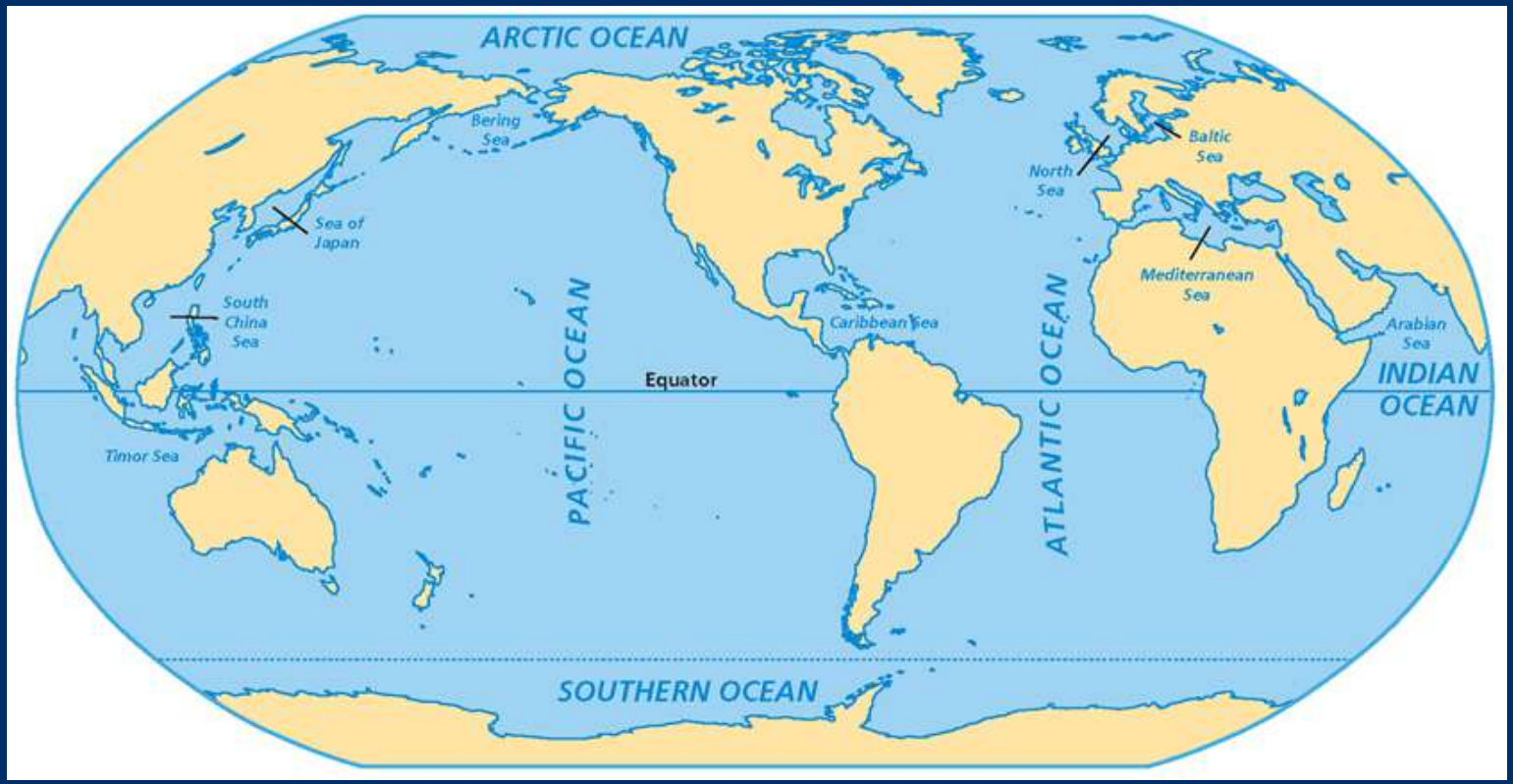
sea a large, commonly saline body of water that is smaller than an ocean and that may be partially or completely surrounded by land

- Examples of major seas include the Mediterranean, Caribbean, and South China Seas.

End Of Slide

Division of the Global Ocean, *continued*

The diagram below shows a map of the global oceans.



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Exploration of the Ocean

The Birth of Oceanography

oceanography the scientific study of the ocean, including the properties and movement of ocean water, the characteristics of the ocean floor, and the organisms that live in the ocean

- The voyage of the HMS *Challenger* laid the foundation for the modern science of oceanography.
- Today, many ships perform oceanographic research.

Reading Check

List three characteristics of the ocean that oceanographers study.

Reading Check

List three characteristics of the ocean that oceanographers study.

Oceanographers study the physical characteristics, chemical composition, and life-forms of the ocean.

End Of Slide

Exploration of the Ocean, *continued*

Sonar

sonar *sound navigation and ranging*, a system that uses acoustic signals and returned echoes to determine the location of objects or to communicate

- Scientists measure the time that the sound waves take to travel from the transmitter, to the ocean floor, and to the receiver in order to calculate the depth of the ocean floor.
- Scientists then use this information to make maps and profiles of the ocean floor.

End Of Slide

Exploration of the Ocean, *continued*

Submersibles

- Underwater research vessels, called *submersibles*, also enable oceanographers to study the ocean depths.
- One such submersible is the *bathysphere*, a spherical diving vessel that remains connected to the research ship for communications and life support.
- Another type of piloted submersible is called a *bathyscaph*, is a self-propelled, free-moving submarine.

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Exploration of the Ocean, *continued*

Submersibles

- Other modern submersibles are submarine robots.
- These robot submersibles are remotely piloted and allow oceanographers to study the ocean depths for long periods of time.

End Of Slide

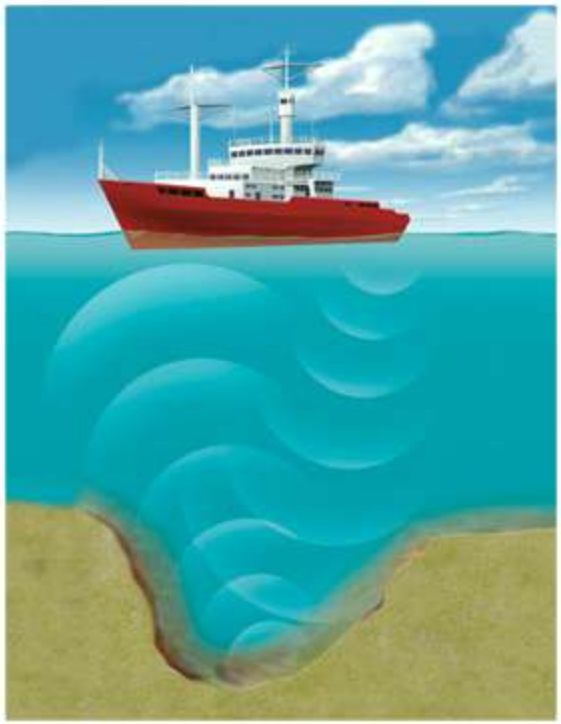
Exploration of the Ocean, *continued*

Underwater Research

- Submersibles have helped scientists make exciting discoveries about the deep ocean.
- During one dive in a submersible, startled oceanographers saw communities of unusual marine life living at depths and temperatures where scientists thought that almost no life could exist.
- Many of these life-forms have unusual adaptations that allow them to live in hostile environments.

End Of Slide

Sonar



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End Of Slide

Objectives

- **Describe** the main features of the continental margins.
- **Describe** the main features of the deep-ocean basin.

End Of Slide

Features of the Ocean Floor

continental margin the shallow sea floor that is located between the shoreline and the deep-ocean bottom

deep-ocean basin the part of the ocean floor that is under deep water beyond the continental margin and that is composed of oceanic crust and a thin layer of sediment

- The ocean floor can be divided into two major areas.

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Continental Margins

- The line that divides the continental crust from the oceanic crust is not abrupt or distinct.
- Shorelines are not the true boundaries between the oceanic crust and the continental crust.
- The boundaries are actually some distance offshore and beneath the ocean and the thick sediments of the continental margin.

End Of Slide

Continental Margins, *continued*

Continental Shelf

- Continents are outlined in most places by a zone of shallow water where the ocean covers the end of the continent.
- The part of the continent that is covered by water is called the *continental shelf*.

- The shelf usually slopes gently from the shoreline and drops about 0.12 m every 100 m.

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Continental Margins, *continued*

Continental Shelf, *continued*

- The average depth of the water covering a continental shelf is about 60 m.
- Although it is underwater, a continental shelf is part of the continental margin, not the deep-ocean basin.
- Changes in sea level affect the continental shelves.

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Continental Margins, *continued*

Continental Slope and Continental Rise

- At the seaward edge of a continental shelf is a steep slope called a *continental slope*.
- The continental shelf and continental slope may be cut by deep V-shaped valleys. These deep valleys are called *submarine canyons*.

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Continental Margins, *continued*

Continental Slope and Continental Rise, *continued*

- Other canyons may form over time as very dense currents called *turbidity currents* carry large amounts of sediment down the continental slopes.
- Turbidity currents form when earthquakes cause underwater landslides or when large sediment loads run down a slope.
- These sediments form a wedge at the base of the continental slope called a *continental rise.*

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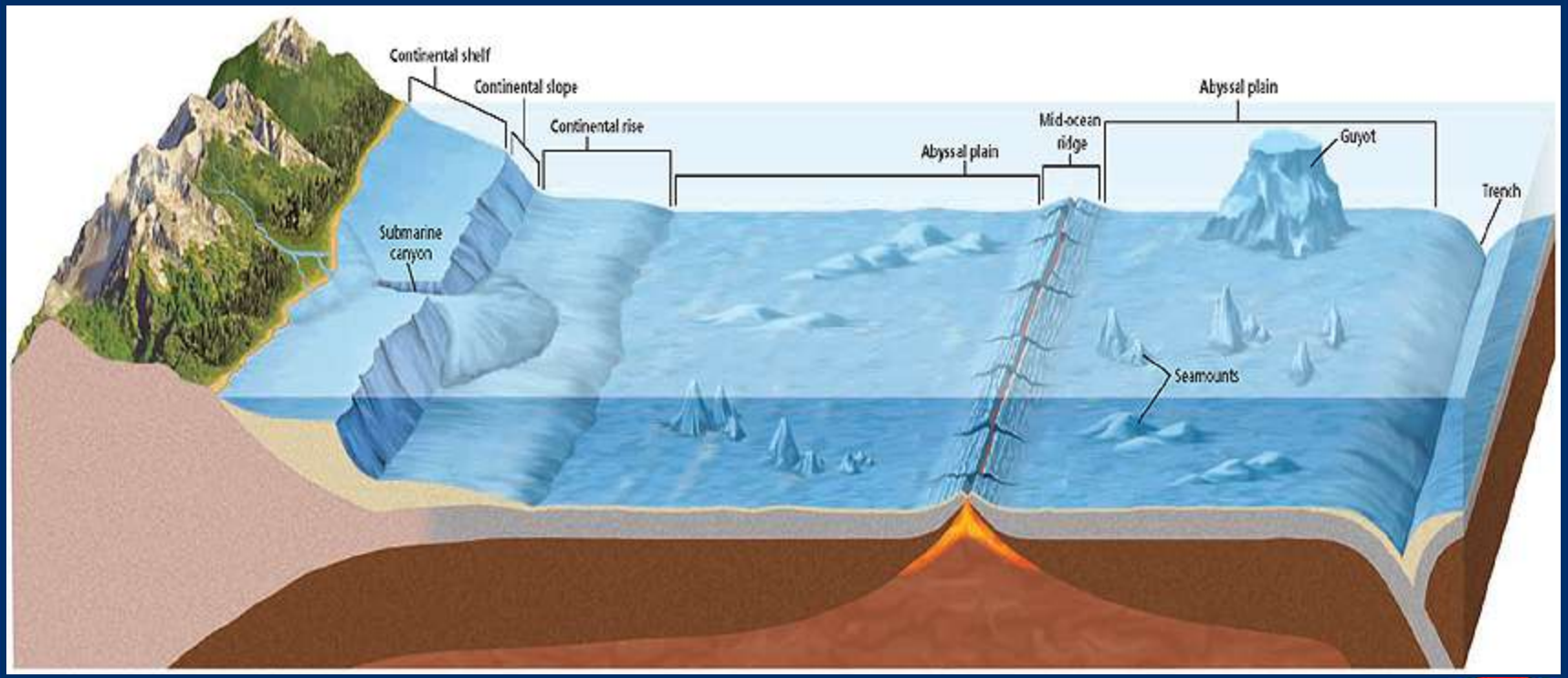
Continental Margins, *continued*

The diagram below shows the features of the ocean floor.



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Deep-Ocean Basins

- Deep-ocean basins also have distinct features.
- These features include broad, flat plains; submerged volcanoes; gigantic mountain ranges; and deep trenches.
- In the deep-ocean basins, the mountains are higher and the plains are flatter than any features found on the continents are.

Reading Check

What features are located in the deep-ocean basins?

Reading Check

What features are located in the deep-ocean basins?

Trenches; broad, flat plains; mountain ranges; and submerged volcanoes are part of the deep-ocean basins.

Deep-Ocean Basins, *continued*

Trenches

trenches a long, narrow, and steep depression that forms on the ocean floor as a result of subduction of a tectonic plate, that runs parallel to the trend of a chain of volcanic islands or the coastline of a continent, and that may be as deep as 11 km below sea level; also called an *ocean trench* or a *deep-ocean trench*

- Earthquakes occur near trenches. Volcanic mountain ranges and volcanic island arcs also form near trenches.

Deep-Ocean Basins, *continued*

Abyssal Plains

abyssal plain a large, flat, almost level area of the deep-ocean basin

- Abyssal plains cover about half of the deep-ocean basins and are the flattest regions on Earth.
- Layers of fine sediment cover the abyssal plains.
- The thickness of sediments on the abyssal plains is determined by three factors.

End Of Slide

Deep-Ocean Basins, *continued*

Mid-Ocean Ridges

- The most prominent features of ocean basins are the *mid-ocean ridges*, which form underwater mountain ranges that run along the floors of all oceans.
- Mid-ocean ridges rise above sea level in only a few places, such as in Iceland.
- Fault-bound blocks of crust that form parallel to the ridges as the lithosphere cools and contracts are called *abyssal hills*.

Deep-Ocean Basins, *continued*

Mid-Ocean Ridges, *continued*

- As ridges adjust to changes in the direction of plate motions, they break into segments that are bounded by faults.
- These faults create areas of rough topography called *fracture zones*, which run perpendicular across the ridge.

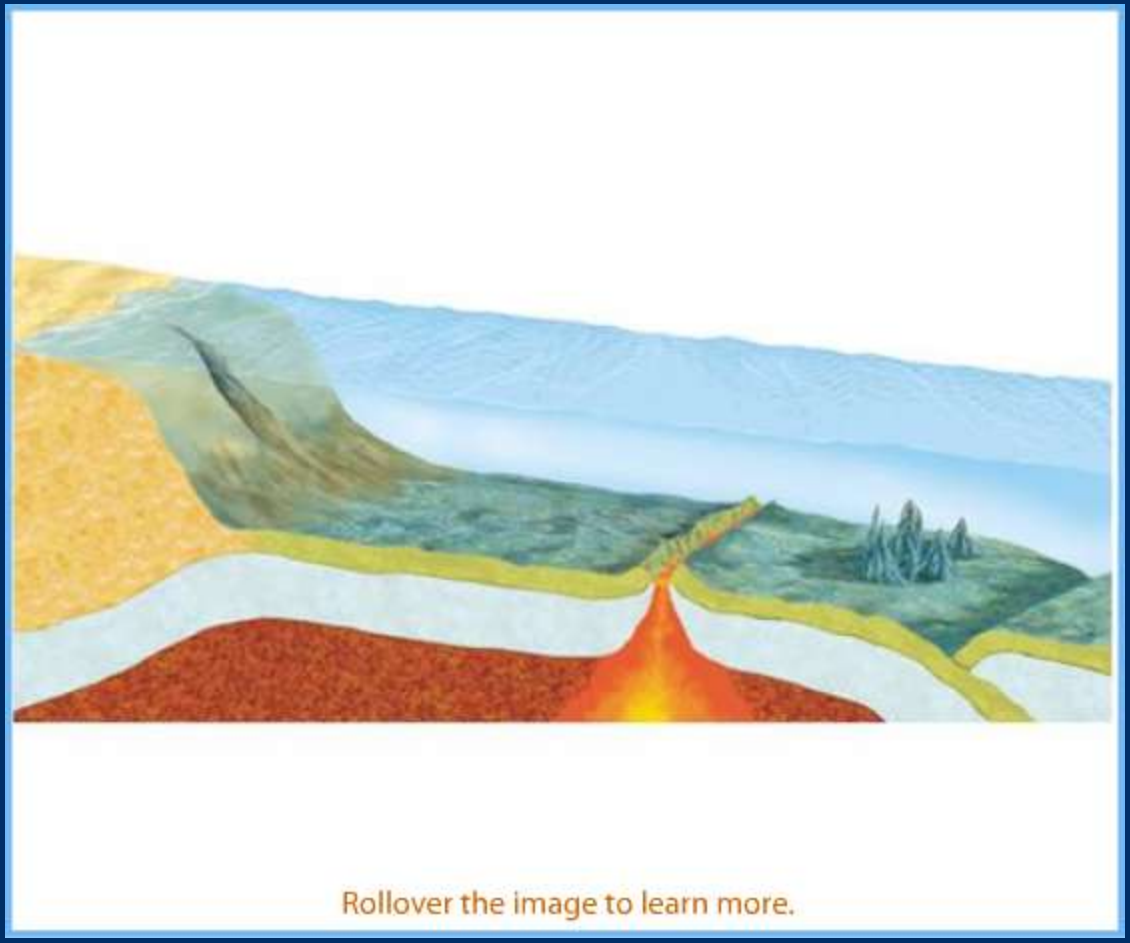
Deep-Ocean Basins, *continued*

Seamounts

- Submerged volcanic mountains that are taller than 1 km are called *seamounts*. Seamounts form in areas of increased volcanic activity called *hot spots*.
- Seamounts that rise above the ocean surface form oceanic islands.
- As tectonic plate movements carry islands away from a hot spot, the islands sink and are eroded by waves to form flat-topped, submerged seamounts called *guyots* or *tablemounts*.

End Of Slide

The Ocean Floor



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Objectives

- **Describe** the formation of ocean-floor sediments.
- **Explain** how ocean-floor sediments are classified by their physical composition.

Ocean-Floor Sediments

- The composition of ocean sediments varies and depends on which part of the ocean floor the sediments form in.
- Coarse gravel and sand are usually found close to shore because these heavier sediments do not move easily offshore.
- Lighter particles are suspended in ocean water and are usually deposited at a great distance from shore.

End Of Slide

Sources of Deep Ocean-Basin Sediments

core sample a cylindrical piece of sediment, rock, soil, snow, or ice that is collected by drilling

- The study of sediment samples show that most of the sediments in the deep-ocean basins are made of materials that settle slowly from the ocean water above.
- These materials may come from organic or inorganic sources.

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Sources of Deep Ocean-Basin Sediments, *continued*

Inorganic Sediments

- Some ocean-basin sediments are rock particles that were carried from land by rivers.
- Other deep ocean-basin sediments consist of fine particles of rock, including volcanic dust, that have been blown great distances out to sea by the wind.
- Icebergs also provide sediments that can end up on the ocean basins. Even meteorites contribute to deep ocean-basin sediments.

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Sources of Deep Ocean-Basin Sediments, *continued*

Biogenic Sediments

- The word *biogenic* comes from the Latin words *bios,* which means “life,” and *genus*, which means “origin.”
- Biogenic sediments are the remains of marine plants and animals. The two most common compounds found in organic sediments are silica, SiO_2, and calcium carbonate, $CaCO_3$.

End Of Slide

Sources of Deep Ocean-Basin Sediments, *continued*

Chemical Deposits

nodule a lump of minerals that is made of oxides of manganese, iron, copper, or nickel and that is found in scattered groups on the ocean floor

- When chemical reactions take place in the ocean, solid materials can form.
- When substances that are dissolved in ocean water crystallize, these materials settle to the ocean floor as potato-shaped lumps of minerals called nodules.

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Reading Check

How do nodules form?

Reading Check

How do nodules form?

When chemical reactions take place in the ocean, dissolved substances can crystallize to form nodules that settle to the ocean floor.

End Of Slide

Physical Classification of Sediments

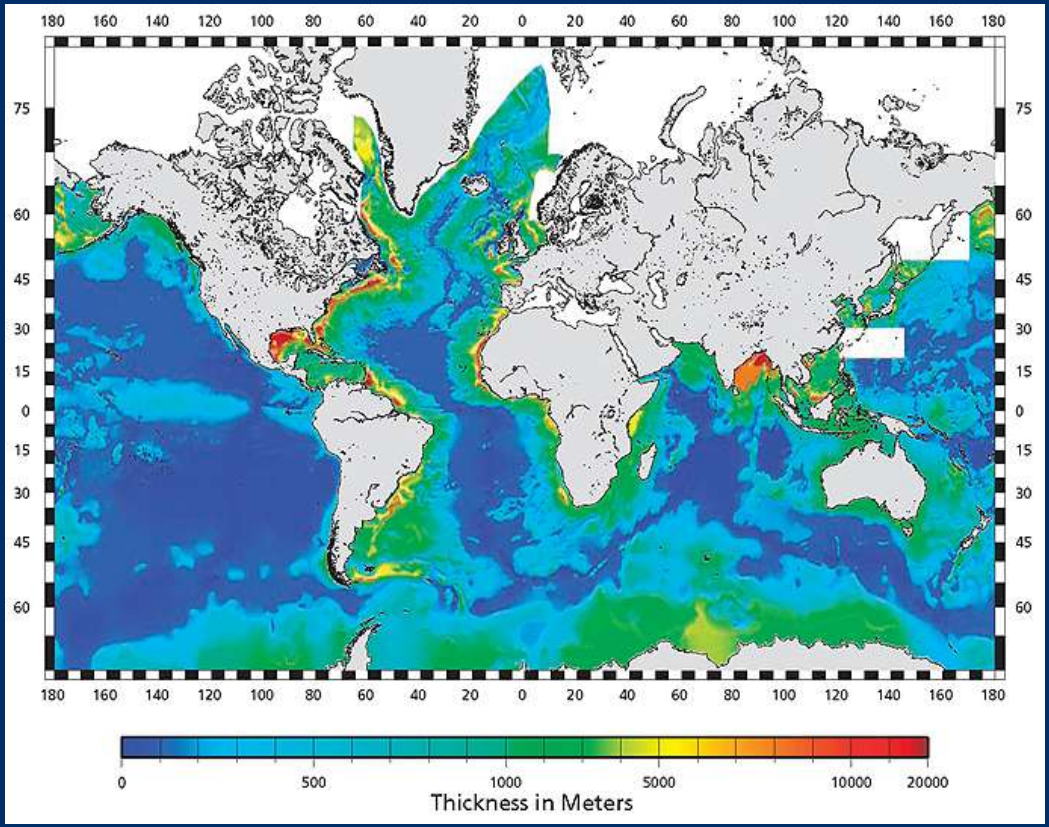
- Based on physical characteristics, deep ocean-floor sediments are classified as mud or as ooze.
- *Muds* are very fine silt- and clay-sized particles of rock.
- *Calcareous ooze* is ooze that is made mostly of calcium carbonate.
- *Siliceous ooze*, which can be found at any depth, is made of mostly silicon dioxide, which comes from the shells of radiolarians and diatoms.

End Of Slide

Brain Food Video Quiz

Maps in Action

Total Sediment Thickness of Earth's Oceans



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Multiple Choice

1. The global ocean is divided into which of the following oceans, in order of decreasing size?

A. Atlantic, Pacific, Arctic, Indian

B. Arctic, Indian, Atlantic, Pacific

C. Pacific, Arctic, Indian, Atlantic

D. Pacific, Atlantic, Indian, Arctic

Multiple Choice

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B. Arctic, Indian, Atlantic, Pacific

C. Pacific, Arctic, Indian, Atlantic

D. Pacific, Atlantic, Indian, Arctic

Multiple Choice, *continued*

2. What is the name for a vast, flat area of a deep-ocean basin?

F. trench

G. seamount

H. abyssal plain

I. mid-ocean ridge

Multiple Choice, *continued*

2. What is the name for a vast, flat area of a deep-ocean basin?

F. trench

G. seamount

H. abyssal plain

I. mid-ocean ridge

Multiple Choice, *continued*

3. What are very fine, silt- and clay-sized particles of rock found on the ocean floor called?

A. muds

B. calcareous ooze

C. siliceous ooze

D. sand

Multiple Choice, *continued*

3. What are very fine, silt- and clay-sized particles of rock found on the ocean floor called?

A. muds

B. calcareous ooze

C. siliceous ooze

D. sand

Multiple Choice, *continued*

4.The study of deep-ocean sediment samples show that

F.most of the sediments came from the crust.

G.most of the sediments settled from above.

H.sediments cannot be organic.

I.sediments cannot be inorganic.

Multiple Choice, *continued*

4.The study of deep-ocean sediment samples show that

F.most of the sediments came from the crust.

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Multiple Choice, *continued*

5. Which of the following affects the ocean's salinity?

A. number of fish

B. wave size

C. evaporation

D. wave speed

Multiple Choice, *continued*

5.Which of the following affects the ocean's salinity?

A.number of fish

B.wave size

C.evaporation

D.wave speed

Short Response, *continued*

6. The surface area of Earth is about 511,000,000 km^2. About 70% of the Earth's surface is covered by water and the Pacific Ocean makes up 50% of this amount. Calculate the surface area of Earth that is covered by the Pacific Ocean.

Short Response, *continued*

6. The surface area of Earth is about 511,000,000 km^2. About 70% of the Earth's surface is covered by water and the Pacific Ocean makes up 50% of this amount. Calculate the surface area of Earth that is covered by the Pacific Ocean.

178,850,000 km^2

Short Response, *continued*

7. What is the name of the process used to remove salt from seawater?

Short Response, *continued*

7. What is the name of the process used to remove salt from seawater?

desalination

Reading Skills

Read the passage below. Then, answer questions 8–10.

Life on a Continental Shelf

While fish, mammals, and other forms of life can be found throughout these ocean waters, most life in the ocean is concentrated near the continental shores. The shallow waters of the continental shelf, which make up less than 10% of the ocean's total surface area, are home to an amazing array of plants, animals, and microscopic organisms.

Organisms such as coral and seaweed can grow on the ocean floor and still receive much needed sunlight that cannot penetrate deeper waters. The sunlight also makes the shallow waters much warmer than deeper abyssal waters. Algae flourishes in these war, nutrient-rich waters and serves as food for many small ocean organisms. These organisms are in turn eaten by larger organisms. Even humans have become part of the food chain on the shelf. The vast majority of fish caught for human consumption are caught in waters above a continental shelf.

Reading Skills, *continued*

8. Which of the following statements about why humans catch so many fish in the waters over a continental shelf can be inferred from the information in the passage?

A. There are no fish in deeper waters.

B. Fish from deeper waters are inedible.

C. Humans do not have the technological ability to catch fish in deeper ocean waters.

D. There are larger more varied fish populations over a continental shelf.

Reading Skills, *continued*

8. Which of the following statements about why humans catch so many fish in the waters over a continental shelf can be inferred from the information in the passage?

A. There are no fish in deeper waters.

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C. Humans do not have the technological ability to catch fish in deeper ocean waters.

D. There are larger more varied fish populations over a continental shelf.

Reading Skills, *continued*

9.Coral reefs stop actively growing at depths of about 70 m. According to the passage, why might this be true?

F.Coral feed on algae in shallow waters.

G.Coral need sunlight to live, and sunlight can penetrate water only to a certain depth.

H.Coral need warmth, and the deeper ocean waters are too cold for them to survive.

I.Coral at greater depths are eaten by fish.

Reading Skills, *continued*

9. Coral reefs stop actively growing at depths of about 70 m. According to the passage, why might this be true?

F. Coral feed on algae in shallow waters.

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H. Coral need warmth, and the deeper ocean waters are too cold for them to survive.

I. Coral at greater depths are eaten by fish.

Reading Skills, *continued*

10. Why might the waters of a continental shelf have more nutrients than abyssal waters?

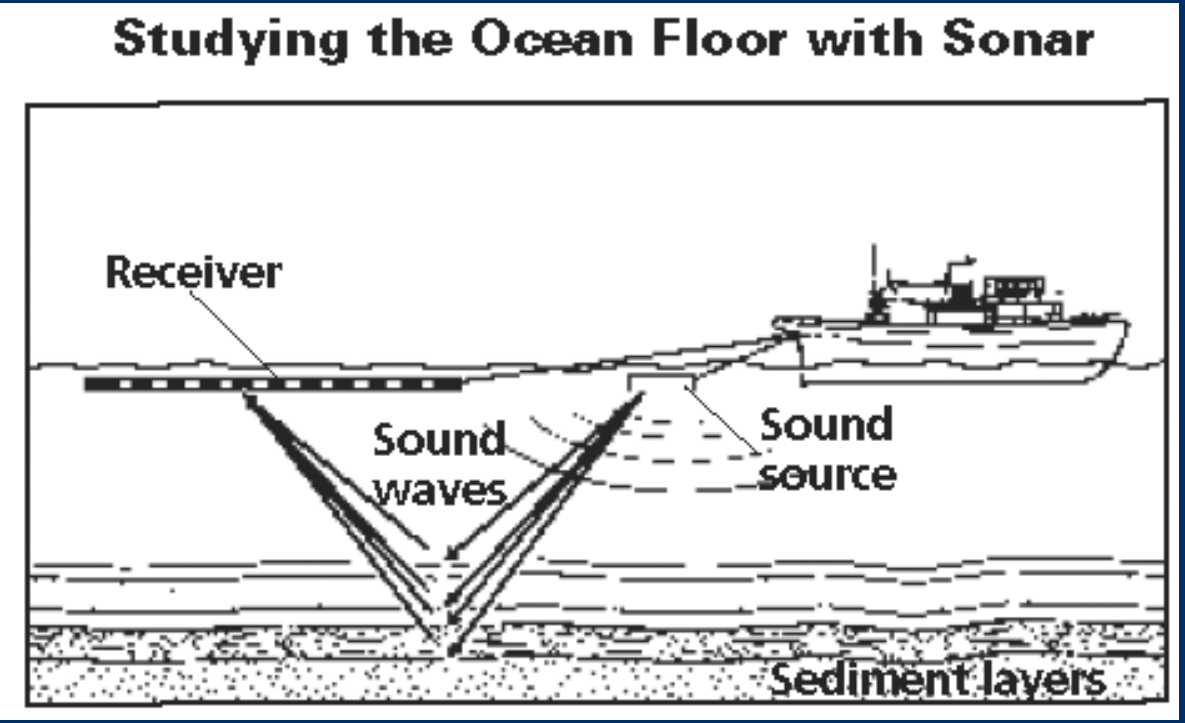
Reading Skills, *continued*

10. Why might the waters of a continental shelf have more nutrients than abyssal waters?

Continental shelf waters have many benefits over deeper ocean waters. The sun makes waters of the shelf rich in plant life. The proximity to land constantly cycles new nutrients into the system by land and river runoff. Upwelling also brings nutrients up from the deeper waters.

Interpreting Graphics

Use the figure below to answer question 11. The image shows how sonar equipment works.



Interpreting Graphics, *continued*

11. Which of the following best summarizes how sound waves are used?

A. A sound source dragged behind the boat emits waves that penetrate the different layers of the sea floor and bounce back to the receiver.

B. A sound source in front of the boat emits waves that penetrate the different layers of the sea floor and then bounce back to the receiver.

C. A receiver dragged behind the boat emits waves that penetrate the different layers of the sea floor and then bounce back to the receiver.

D. A receiver in front of the boat emits waves that penetrate the different layers of the sea floor and the bounce back to the receiver.

Interpreting Graphics, *continued*

11. Which of the following best summarizes how sound waves are used?

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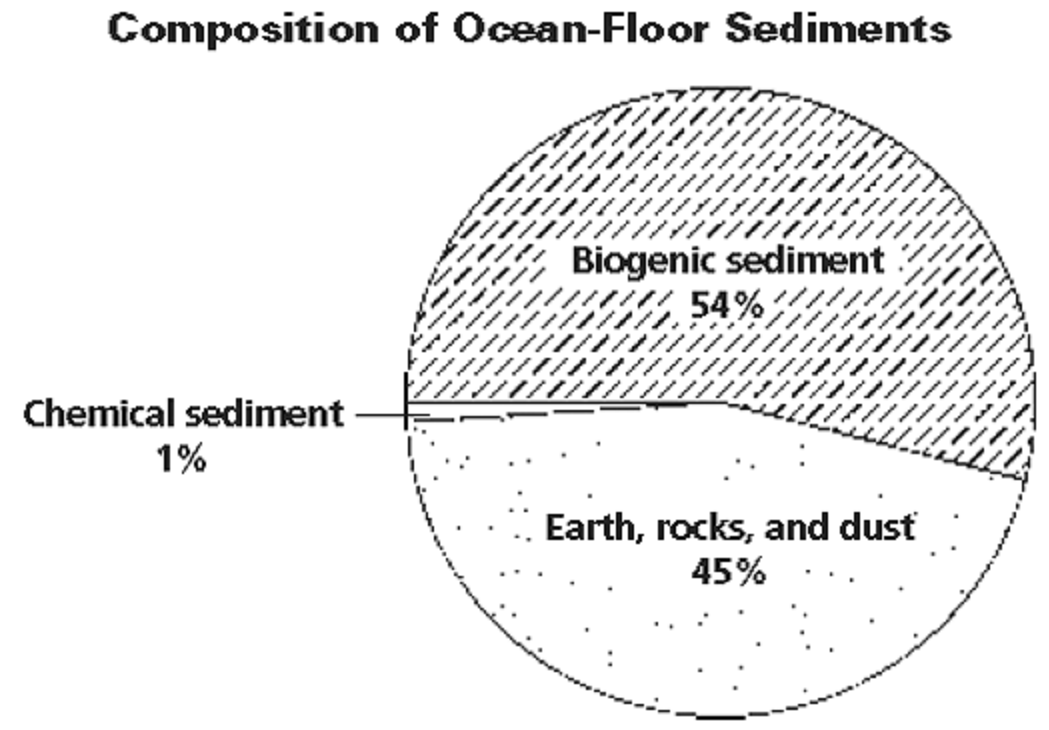
Interpreting Graphics, *continued*

Use the graph below to answer questions 12-13. The graph shows the composition of ocean-floor sediments.



Interpreting Graphics, *continued*

12. Why is there such a large difference between the percentage of biogenic sediment and the percentage of chemical sediment?

Interpreting Graphics, *continued*

12. Why is there such a large difference between the percentage of biogenic sediment and the percentage of chemical sediment?

Answers should include: biologic productivity in the oceans far outstrips the inorganic chemical reactions taking place in the oceans; biologic organisms are also able to reproduce and thus provide a continuous source of sediment as the organisms die; biogenic sediment is found mostly in the form of animal remains.

Interpreting Graphics, *continued*

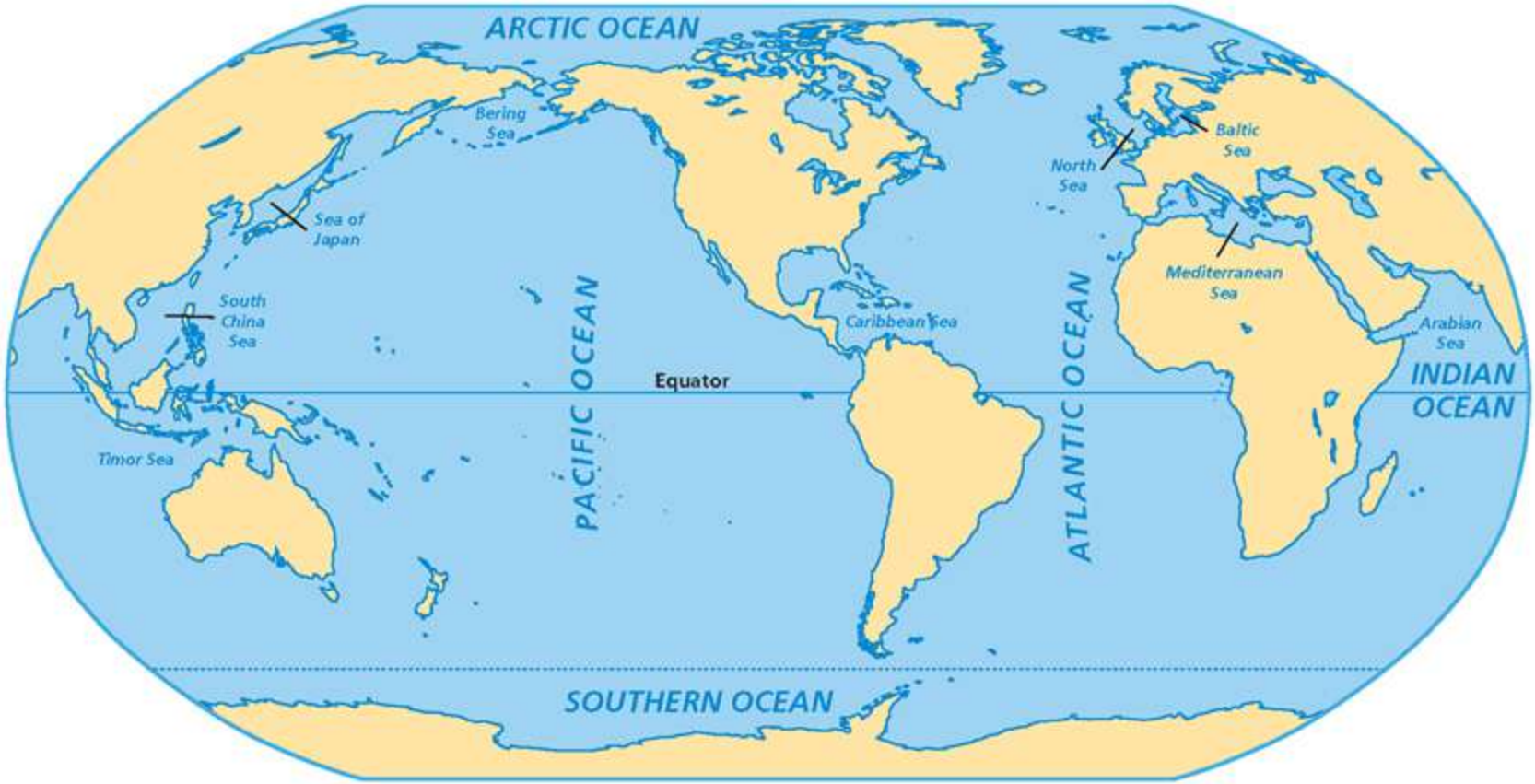
13. How did the inorganic materials in the two kinds of inorganic sediment shown on the pie graph above form and become part of the ocean floor?

Interpreting Graphics, *continued*

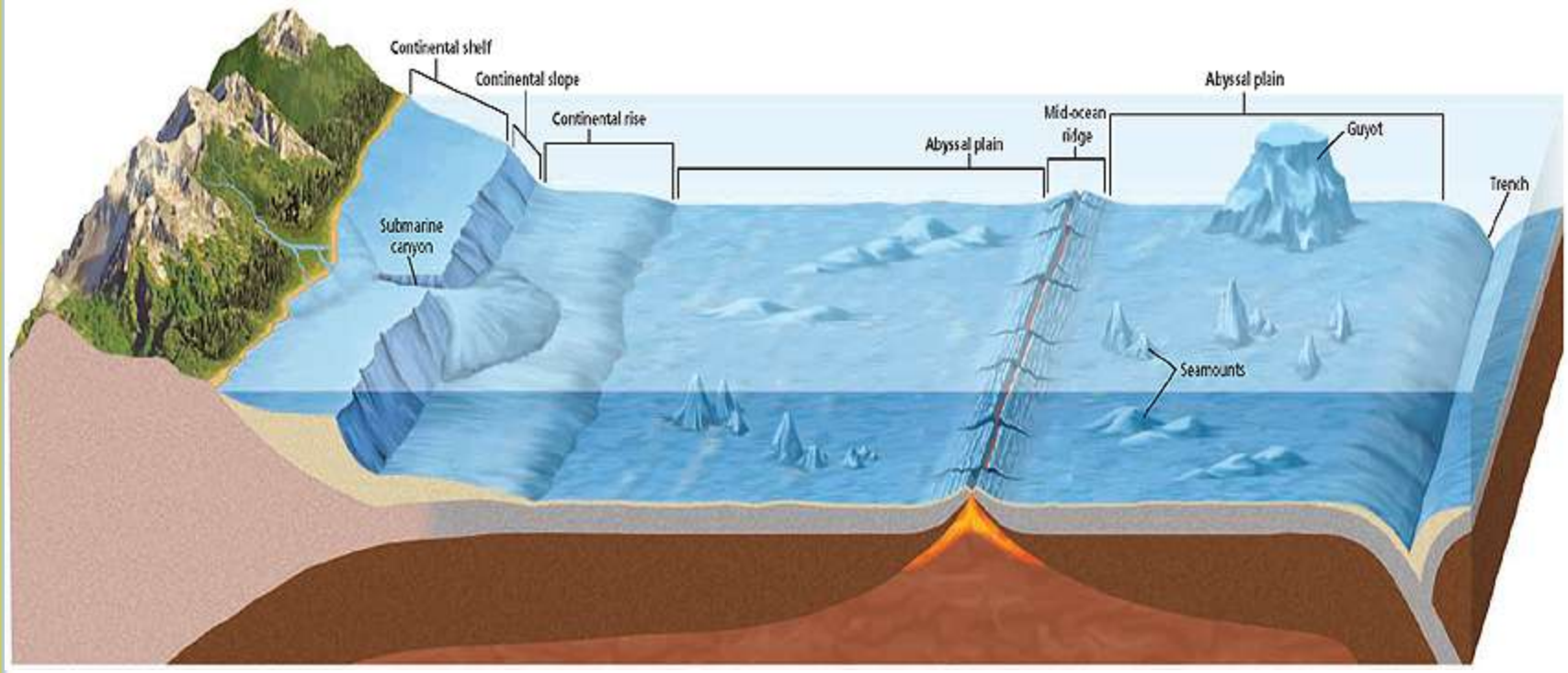
13. How did the inorganic materials in the two kinds of inorganic sediment shown on the pie graph above form and become part of the ocean floor?

Chemical sediment precipitated from the sea water; rocks and dust formed on land and were carried to the ocean by erosion.

The Global Ocean



Features of the Ocean Floor



Total Sediment Thickness of the Earth's Oceans