

Chapter

14

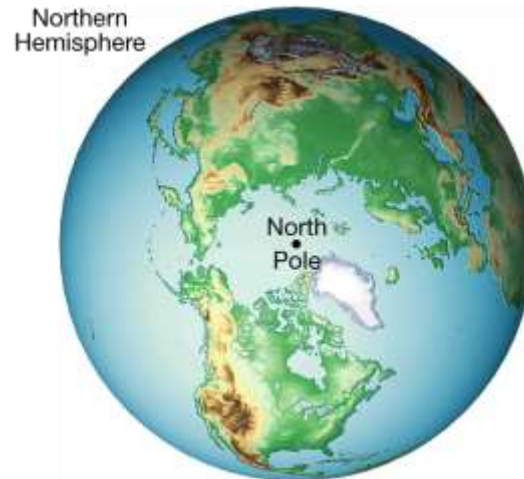
The Ocean Floor

14.1 The Vast World Ocean

The Blue Planet

- ◆ Nearly 71 percent of Earth's surface is covered by the global ocean.
- ◆ **Oceanography** is a science that draws on the methods and knowledge of geology, chemistry, physics, and biology to study all aspects of the world ocean.

The World Ocean



14.1 The Vast World Ocean

Geography of the Oceans

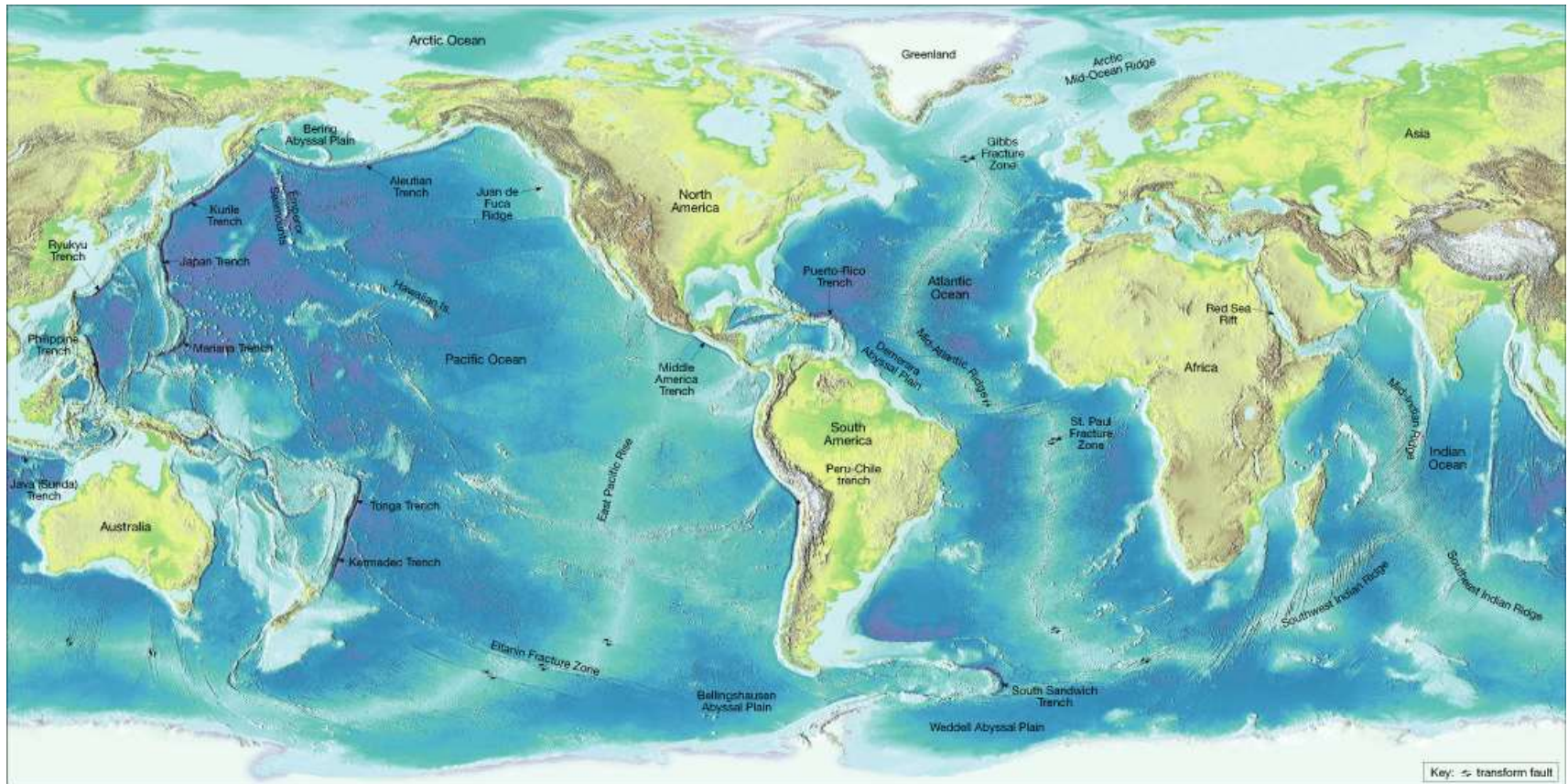
- ◆ The world ocean can be divided into four main ocean basins—the Pacific Ocean, the Atlantic Ocean, the Indian Ocean, and the Arctic Ocean.
 - The Pacific Ocean is the largest and has the greatest depth.
 - The Atlantic Ocean is about half the size of the Pacific and not quite as deep.
 - The Indian Ocean, largely a southern hemisphere body, is slightly smaller than the Atlantic.
 - The Arctic Ocean is about 7 percent of the size of the Pacific.

14.1 The Vast World Ocean

Mapping the Ocean Floor

- ◆ The topography of the ocean floor is as diverse as that of the continents.
- ◆ **Bathymetry** is the measurement of ocean depths and the charting of the shape or topography of the ocean floor.
- ◆ Today's technology—particularly sonar, satellites, and submersibles—allows scientists to study the ocean floor in a more efficient and precise manner than ever before.

The Topography of the Ocean



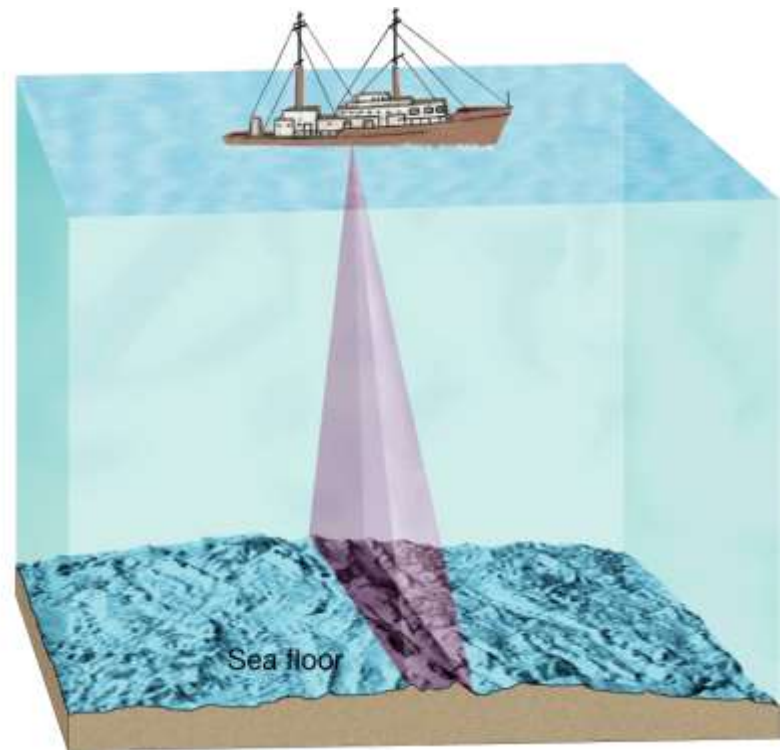
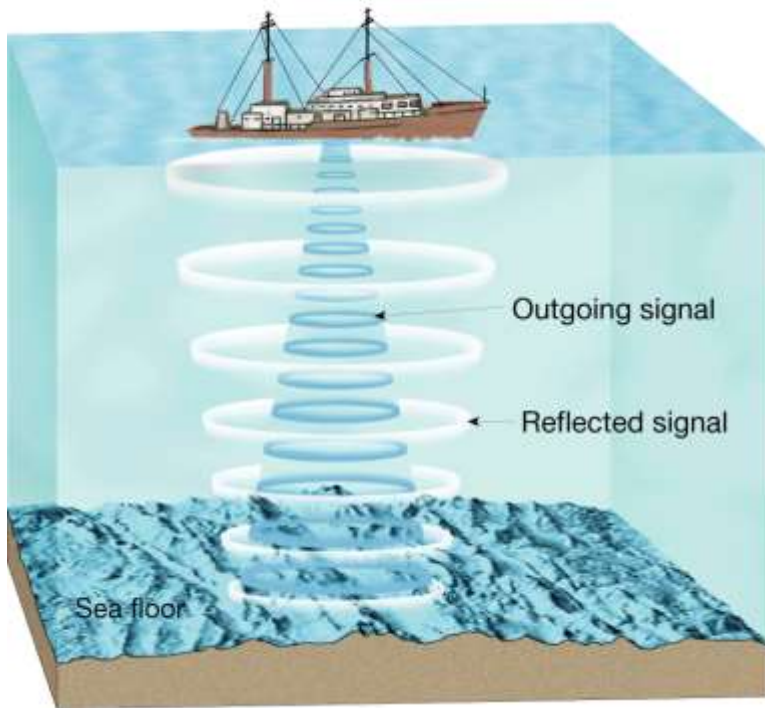
14.1 The Vast World Ocean

Mapping the Ocean Floor

◆ Sonar

- **Sonar** is an acronym for **s**ound **n**avigation and **r**anging. It is also referred to as echo sounding.
- Sonar works by transmitting sound waves toward the ocean bottom.

Sonar Methods



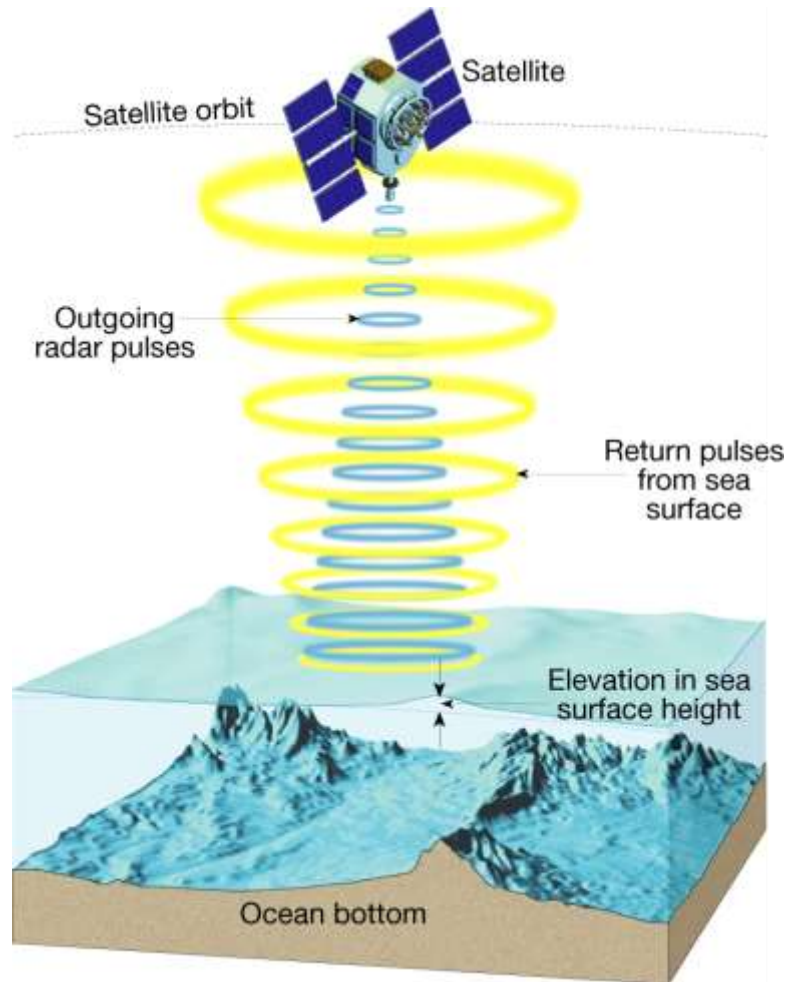
14.1 The Vast World Ocean

Mapping the Ocean Floor

◆ Satellites

- Satellites are able to measure small differences by bouncing microwaves off the ocean surface.
- Using this new technology, scientists have discovered that the ocean surface is not perfectly flat.
- Differences in the height of the ocean surface are caused by ocean-floor features.

Satellite Methods



14.1 The Vast World Ocean

Mapping the Ocean Floor

◆ Submersibles

- **Submersibles** are small underwater crafts used for deep-sea research.
- Today, many submersibles are unmanned and operated remotely by computers. These remotely operated vehicles (ROVs) can remain underwater for long periods.

14.2 Ocean Floor Features

Mapping the Ocean Floor

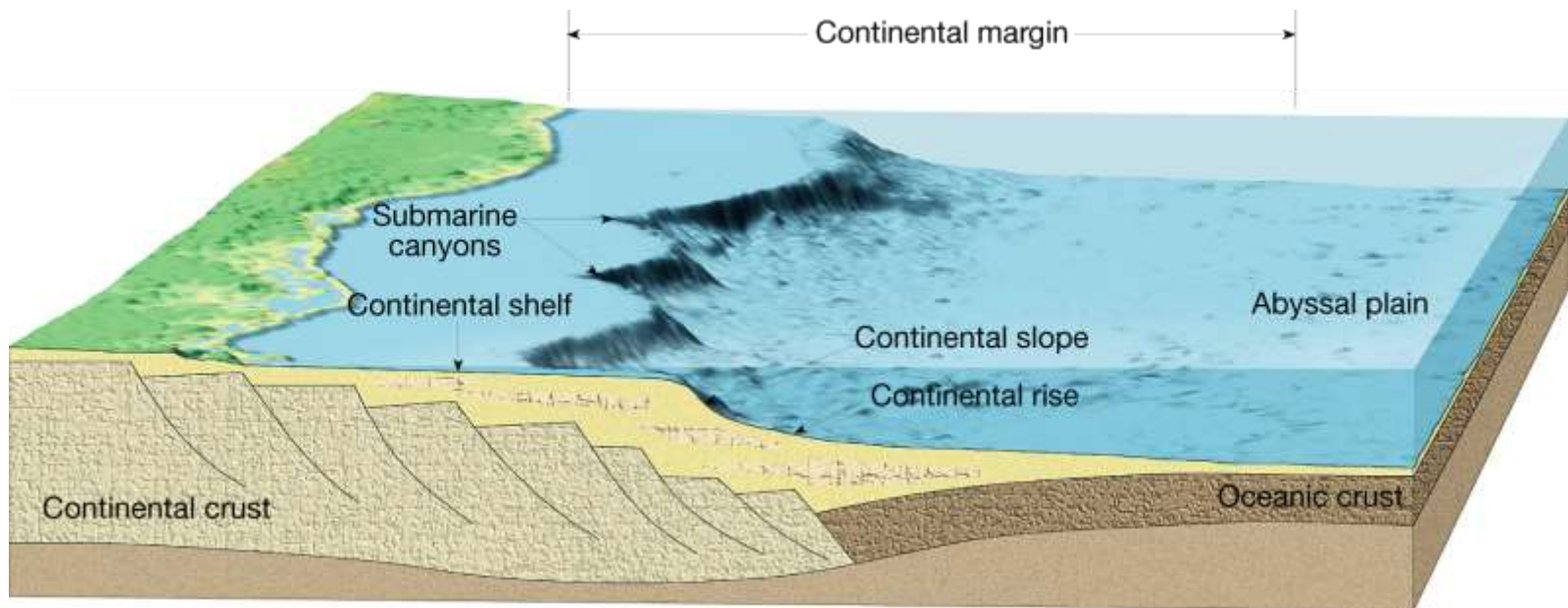
- ◆ The ocean floor regions are the continental margins, the ocean basin floor, and the mid-ocean ridge.

14.2 Ocean Floor Features

Continental Margins

- ◆ A **continental margin** is the zone of transition between a continent and the adjacent ocean basin floor.
- ◆ In the Atlantic Ocean, thick layers of undisturbed sediment cover the continental margin. This region has very little volcanic or earthquake activity.

Atlantic Continental Margin



14.2 Ocean Floor Features

Continental Margins

- ◆ In the Pacific Ocean, oceanic crust plunges beneath continental crust. This force results in a narrow continental margin that experiences both volcanic activity and earthquakes.

14.2 Ocean Floor Features

Continental Margins

◆ Continental Shelf

- A **continental shelf** is the gently sloping submerged surface extending from the shoreline.
- Continental shelves contain important mineral deposits, large reservoirs of oil and natural gas, and huge sand and gravel deposits.

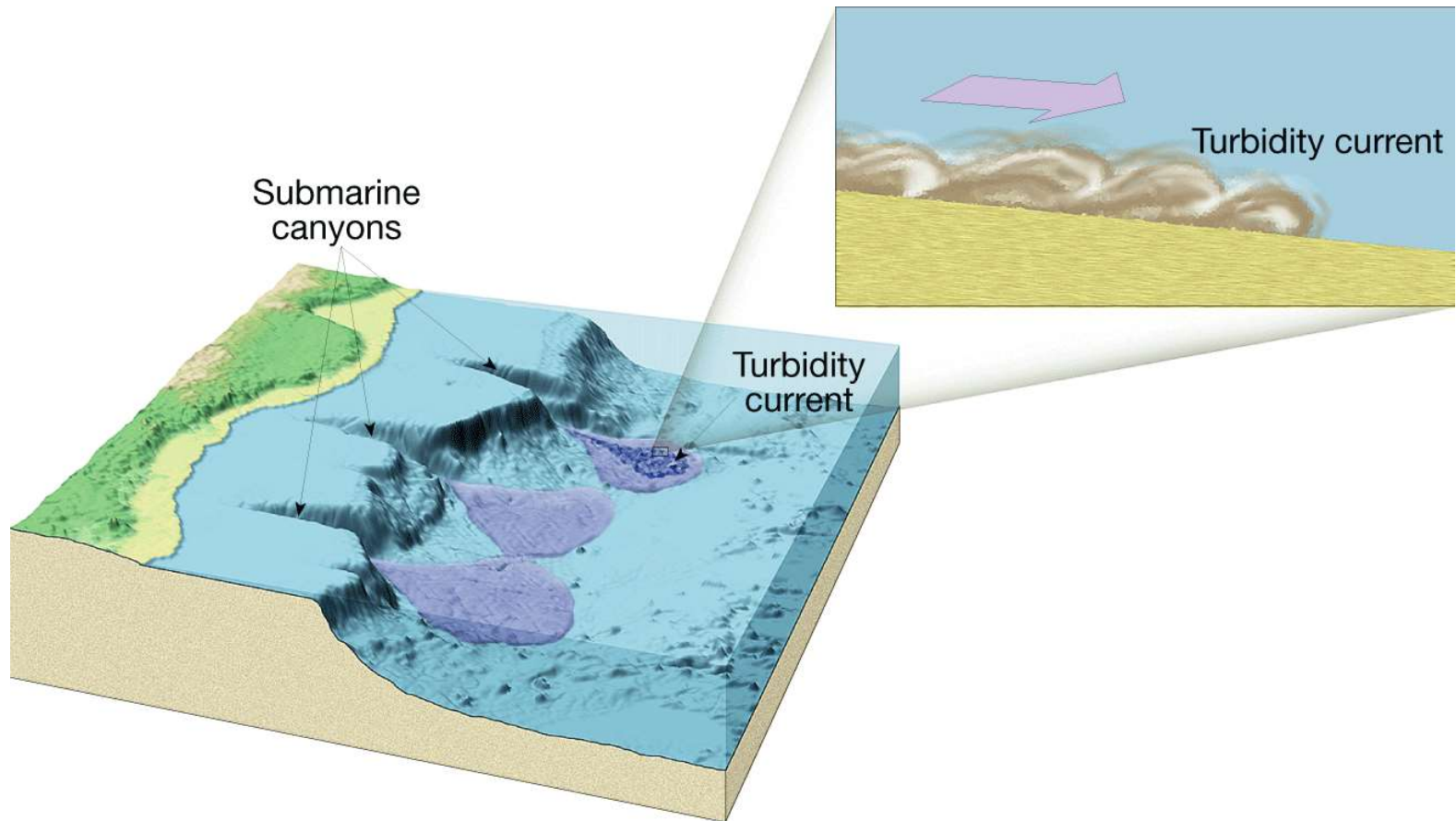
14.2 Ocean Floor Features

Continental Margins

◆ Continental Slope

- A **continental slope** is the steep gradient that leads to the deep-ocean floor and marks the seaward edge of the continental shelf.
- A **submarine canyon** is the seaward extension of a valley that was cut on the continental shelf during a time when sea level was lower—a canyon carved into the outer continental shelf, slope, and rise by turbidity currents.
- A **turbidity current** is the downslope movement of dense, sediment-laden water created when sand and mud on the continental shelf and slope are dislodged and thrown into suspension.

Submarine Canyons



14.2 Ocean Floor Features

Continental Margins

◆ Continental Rise

- A **continental rise** is the gently sloping surface at the base of the continental slope.

14.2 Ocean Floor Features

Ocean Basin Floor

- ◆ The **ocean basin floor** is the area of the deep-ocean floor between the continental margin and the oceanic ridge.
- ◆ Deep-Ocean Trenches
 - Trenches form at the sites of plate convergence where one moving plate descends beneath another and plunges back into the mantle.

14.2 Ocean Floor Features

Ocean Basin Floor

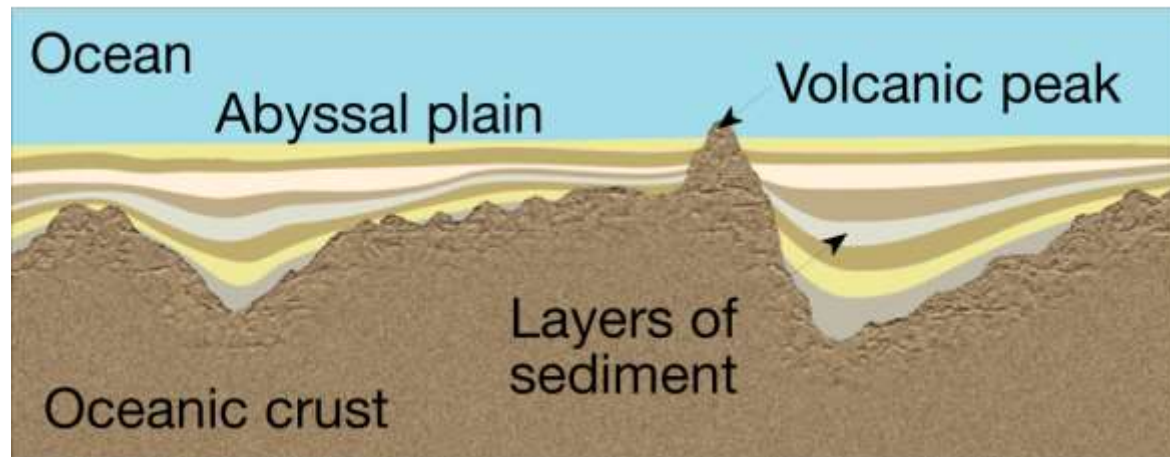
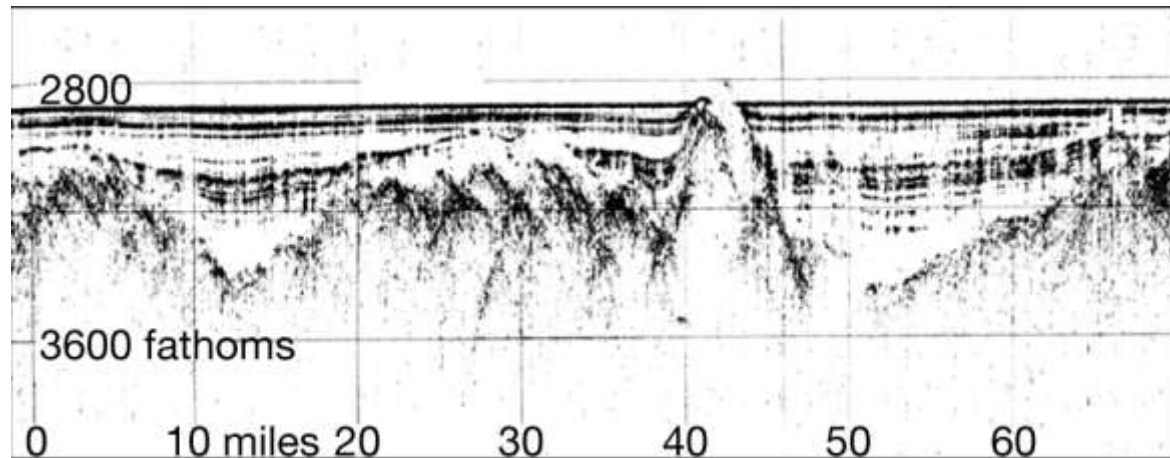
◆ Abyssal Plains

- An **abyssal plain** is a very level area of the deep-ocean floor, usually lying at the foot of the continental rise.
- The sediments that make up abyssal plains are carried there by turbidity currents or are deposited as suspended sediment settles out.

◆ Seamounts and Guyots

- A **seamount** is an isolated volcanic peak that rises at least 1000 meters above the deep-ocean floor, and a **guyot** is an eroded, submerged seamount.

Abyssal Plain Cross Section



14.2 Ocean Floor Features

Mid-Ocean Ridges

- ◆ A **mid-ocean ridge** is found near the center of most ocean basins. It is an interconnected system of underwater mountains that have developed on newly formed ocean crust.
- ◆ **Seafloor Spreading**
 - **Seafloor spreading** is the process by which plate tectonics produces new oceanic lithosphere at ocean ridges.
 - New ocean floor is formed at mid-ocean ridges as magma rises between the diverging plates and cools.

14.2 Ocean Floor Features

Mid-Ocean Ridges

◆ Hydrothermal Vents

- Hydrothermal vents form along mid-ocean ridges. These are zones where mineral-rich water, heated by the hot, newly-formed oceanic crust, escapes through cracks in the oceanic crust into surrounding water.

14.3 Seafloor Sediments

Types of Seafloor Sediments

- ◆ Ocean-floor sediments can be classified according to their origin into three broad categories: terrigenous sediment, biogenous sediment, and hydrogenous sediment.
- ◆ Terrigenous Sediment
 - **Terrigenous sediments** consist primarily of mineral grains that were eroded from continental rocks and transported to the ocean.

14.3 Seafloor Sediments

Types of Seafloor Sediments

◆ Biogenous Sediment

- **Biogenous sediments** consist of shells and skeletons of marine animals and algae.
 - **Calcareous ooze** is thick, common biogenous sediment produced by dissolving calcium carbonate shells.
 - **Siliceous ooze** is biogenous sediment composed of silica-based shells of single-celled animals and algae.

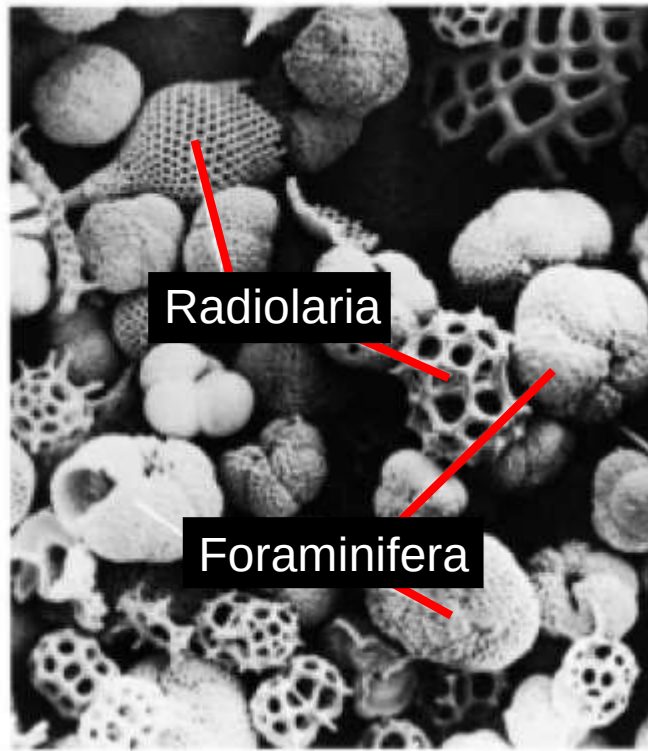
14.3 Seafloor Sediments

Types of Seafloor Sediments

◆ Hydrogenous Sediment

- **Hydrogenous sediment** consists of minerals that crystallize directly from ocean water through various chemical reactions.

Biogenous Sediments



14.4 Resources from the Seafloor

Energy Resources

- ◆ Oil and natural gas are the main energy products currently being obtained from the ocean floor.
- ◆ Gas Hydrates
 - **Gas hydrates** are compact chemical structures made of water and natural gas.
 - Most oceanic gas hydrates are created when bacteria break down organic matter in ocean-floor sediments.

Gas Hydrates



14.4 Resources from the Seafloor

Other Resources

- ◆ Other major resources from the ocean floor include sand and gravel, evaporative salts, and manganese nodules.
- ◆ Sand and Gravel
 - The offshore sand-and-gravel industry is second in economic value only to the petroleum industry.

14.4 Resources from the Seafloor

Other Resources

◆ Manganese Nodules

- **Manganese nodules** are hard lumps of manganese and other metals (like cobalt, copper, and iron) that precipitate around a small object.

◆ Evaporative Salts

- When seawater evaporates, the salt increases in concentration until it can no longer remain dissolved. When the concentration becomes high enough, the salts precipitate out of solution and form salt deposits.
- The most economically important salt is halite—common table salt.

Manganese Nodules

