Fourth Edition

Invitation to Oceanography

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Chapter 4

Marine Sedimentation

Classification of marine sediments can be based upon size or origin

- Size classification divides sediment by grain size into gravel, sand, silt and clay.
  - Mud is a mixture of silt and clay.

- Origin classification divides sediment into five categories:
  - terrigenous sediments
  - biogenous sediments
  - hydrogenous sediments
  - volcanogous sediments
  - cosmogenous sediments

Figure B4-3 Sediment Cores

- Factors that control sedimentation include:
  - particle size
  - the turbulence of the depositional environment

- Terrigenous sediments strongly reflect their source.
  - They are transported to the sea by wind, rivers and glaciers.

- Rate of erosion is important in determining nature of sediments.

- Average grain size reflects the energy of the depositional environment.

Sea Level Fluctuation and Coastlines

Past fluctuations of sea level have stranded coarse (relict) sediment across the shelf.

- This includes most areas where only fine sediments are deposited today.

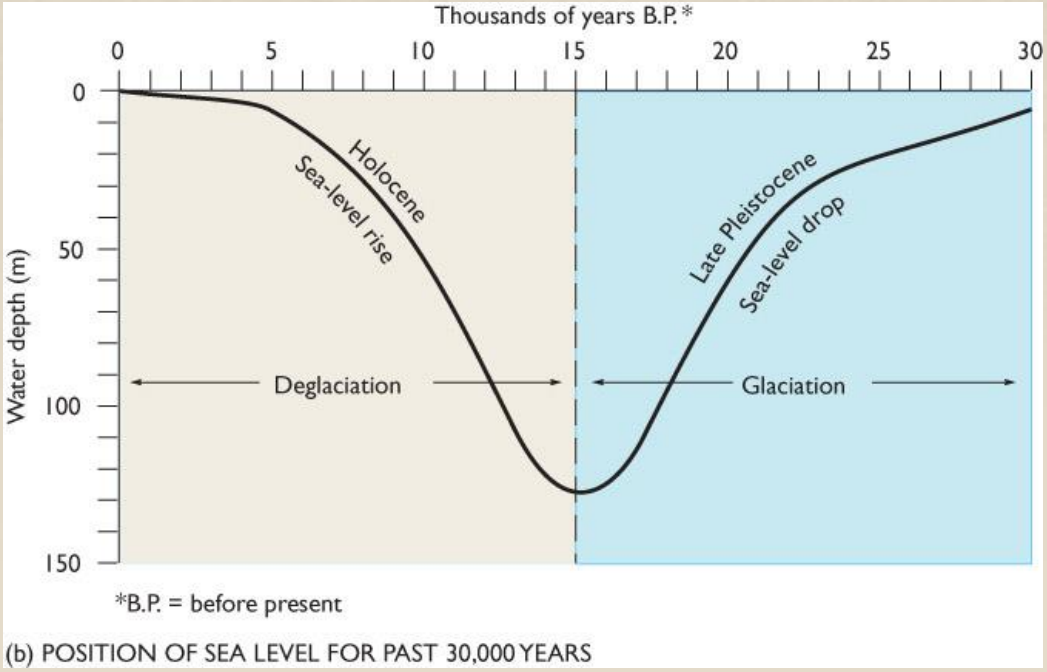


Figure 4-2 Shelf Sedimentation

Shelf Sedimentation

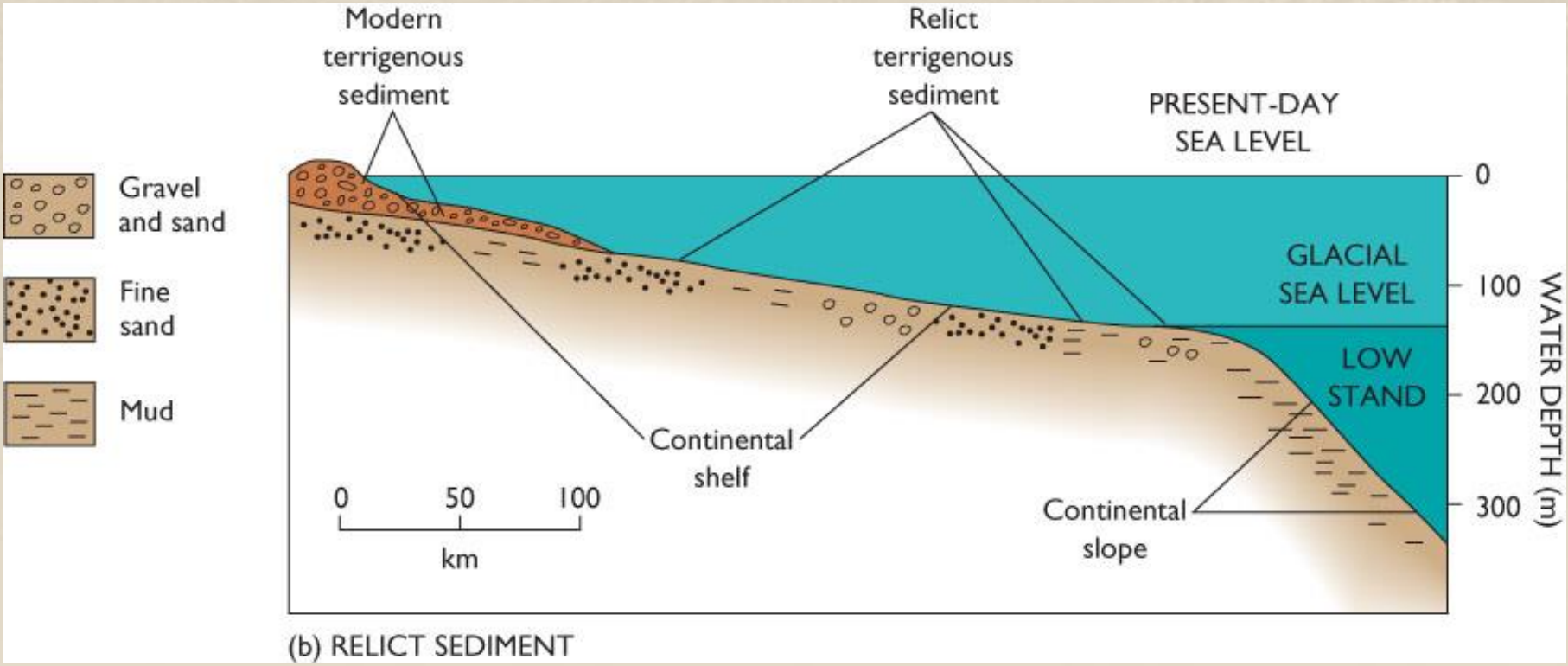


Figure 4-3b Relict Sediment

- Worldwide distribution of recent shelf sediments by composition is strongly related to **latitude** and **climate**.

- Calcareous biogenous sediments dominate tropical shelves.

- River-supplied sands and muds dominate temperate shelves.

- Glacial till and ice-rafted sediments dominate polar shelves.

Shelf Sedimentation Model

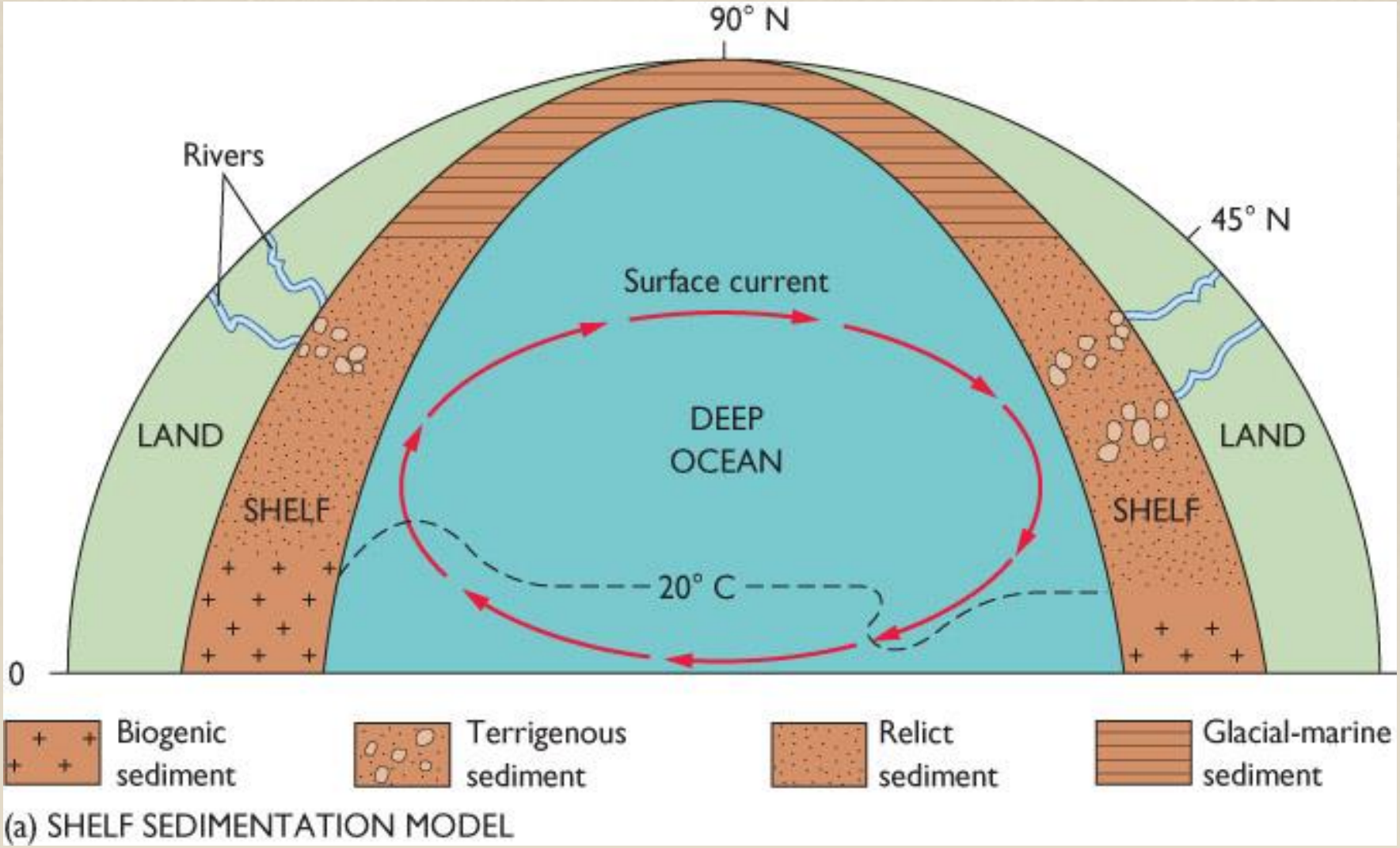


Figure 4-4a Shelf Sedimentation Model

If influx of terrigenous sediment is low and the water is warm, **carbonate** sediments and reefs will dominate.

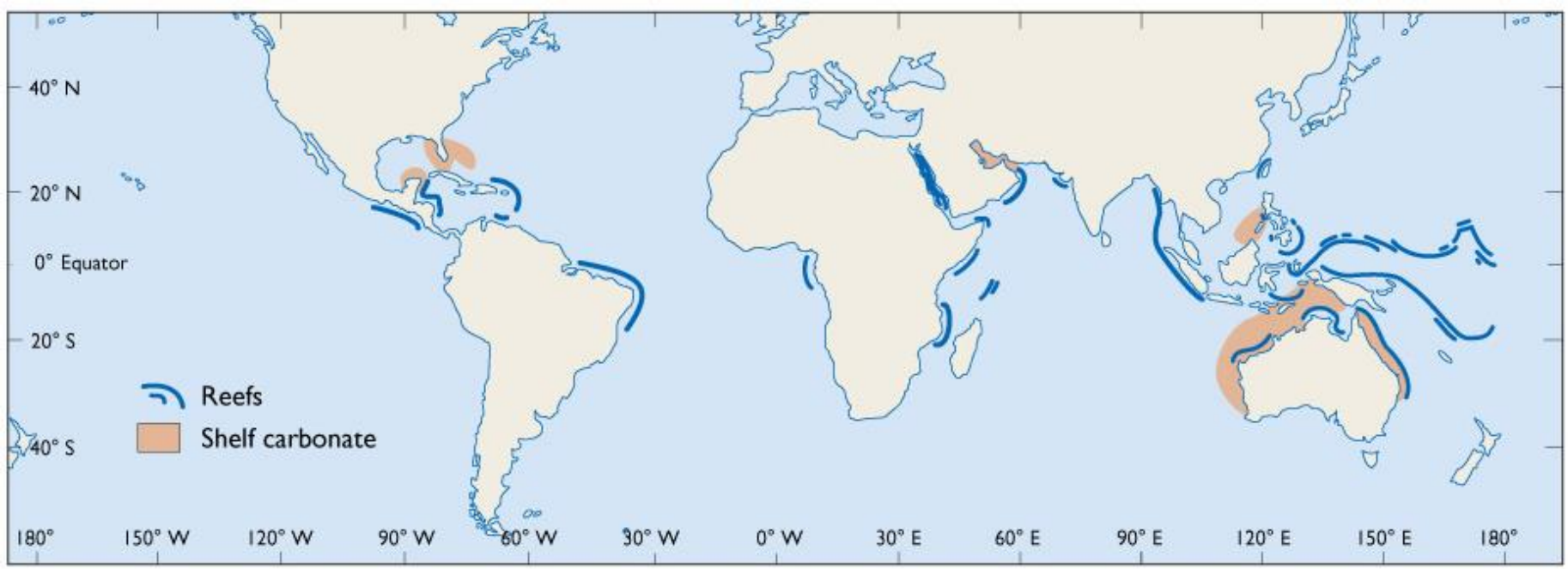


Figure 4-8 Distribution of Carbonate Shelves

- Deep-sea Sedimentation has two main sources of sediment:
  - **External** – terrigenous material from the land
  - **Internal** – biogenous and hydrogenous from the sea.

Deep-Sea Sedimentation

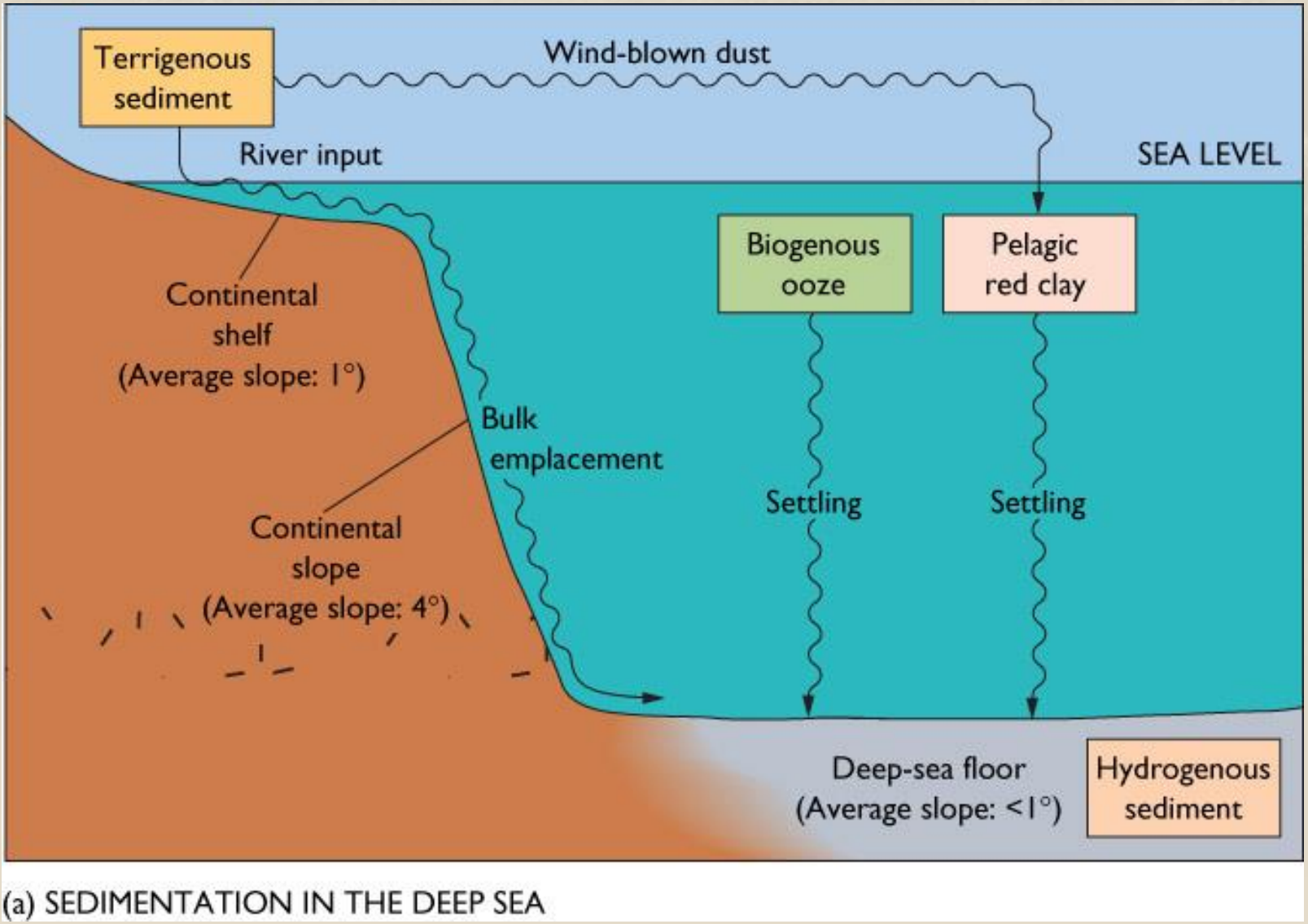
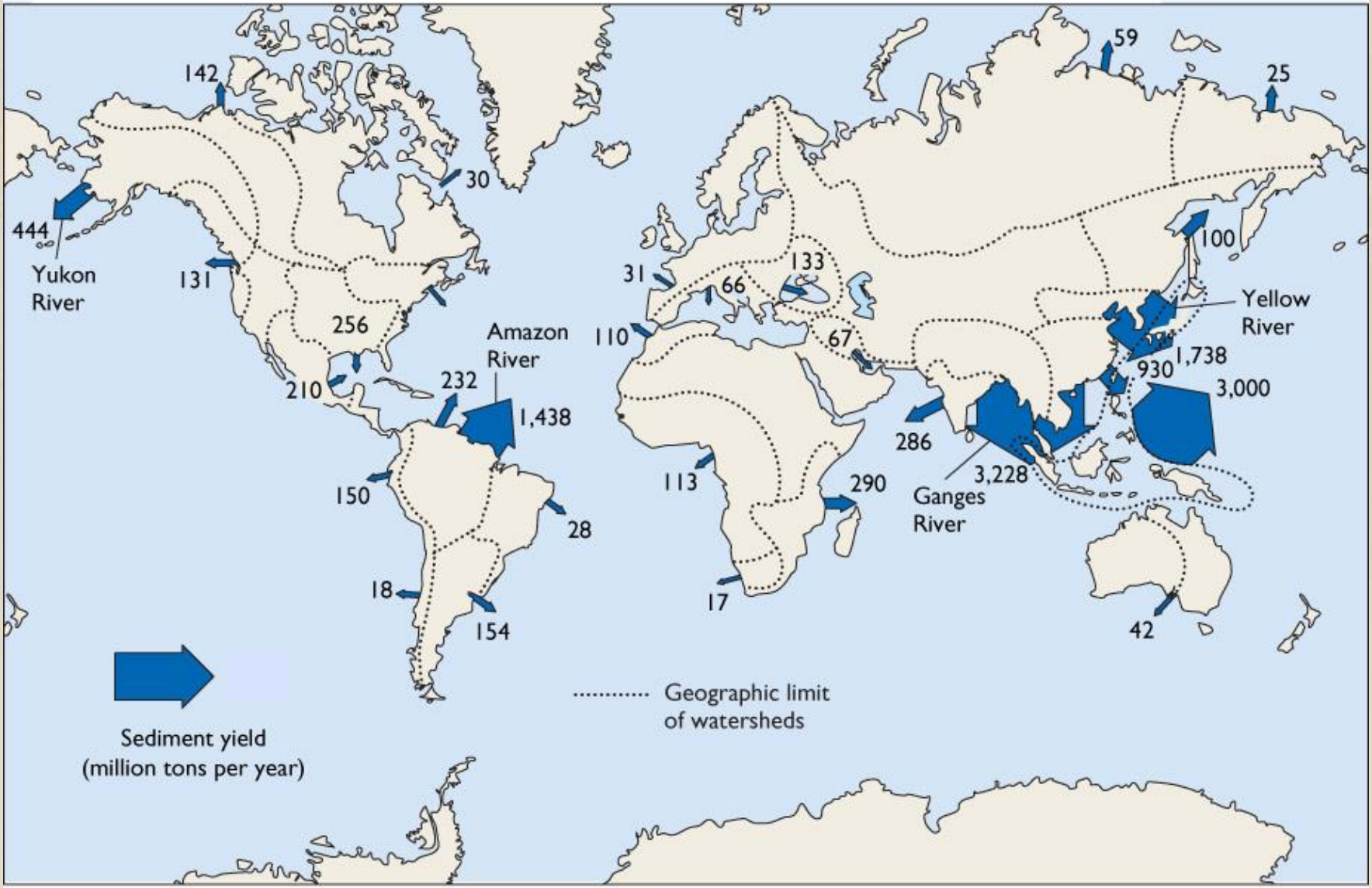


Figure 4-9a Sedimentation in the Deep Sea



(b) RIVER INPUT OF SILT TO OCEANS

Figure 4-9b River Input of Silt to Oceans

4-2 Sedimentation in the Ocean

- Major sedimentary processes in the deep sea include:
  - Bulk emplacement
  - Debris flows
  - Turbidity currents

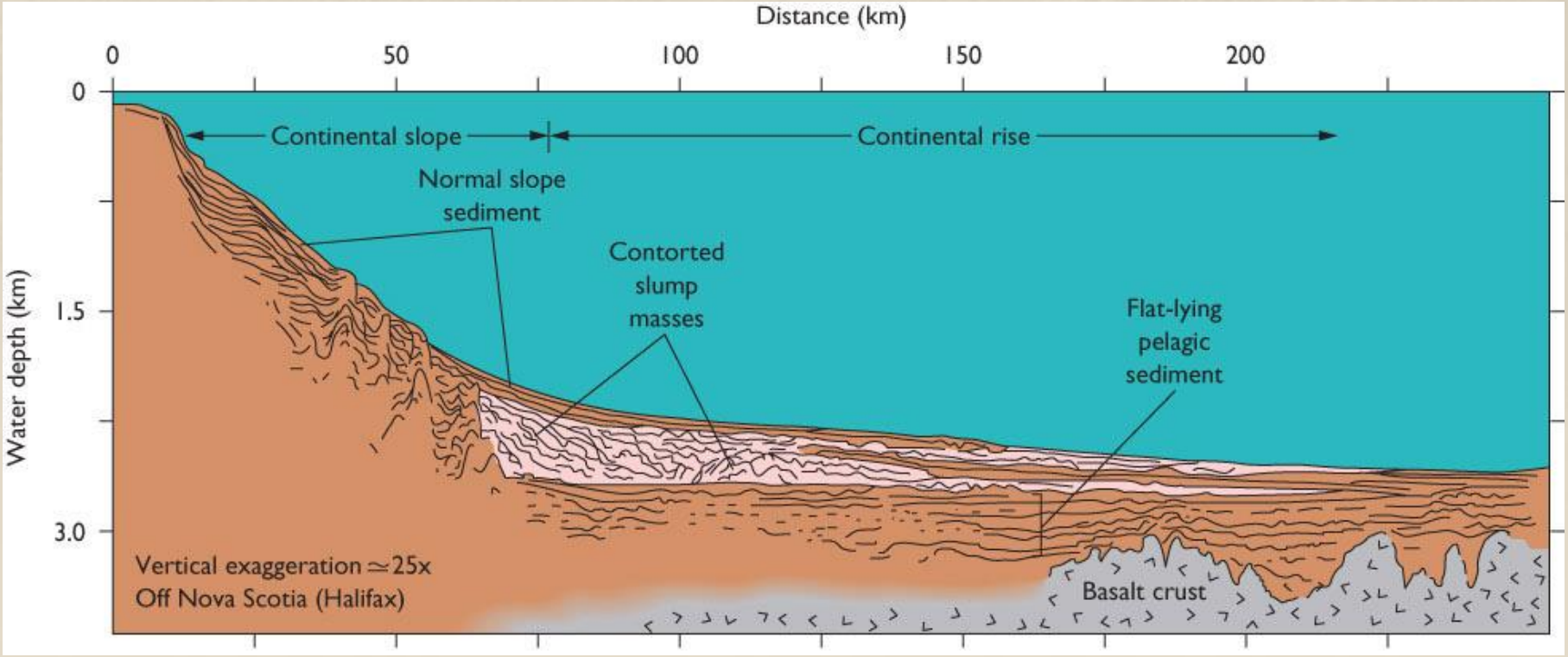


Figure 4-10a Seismic-Reflection Profile

Bulk Emplacement of Sediment to the Deep Sea

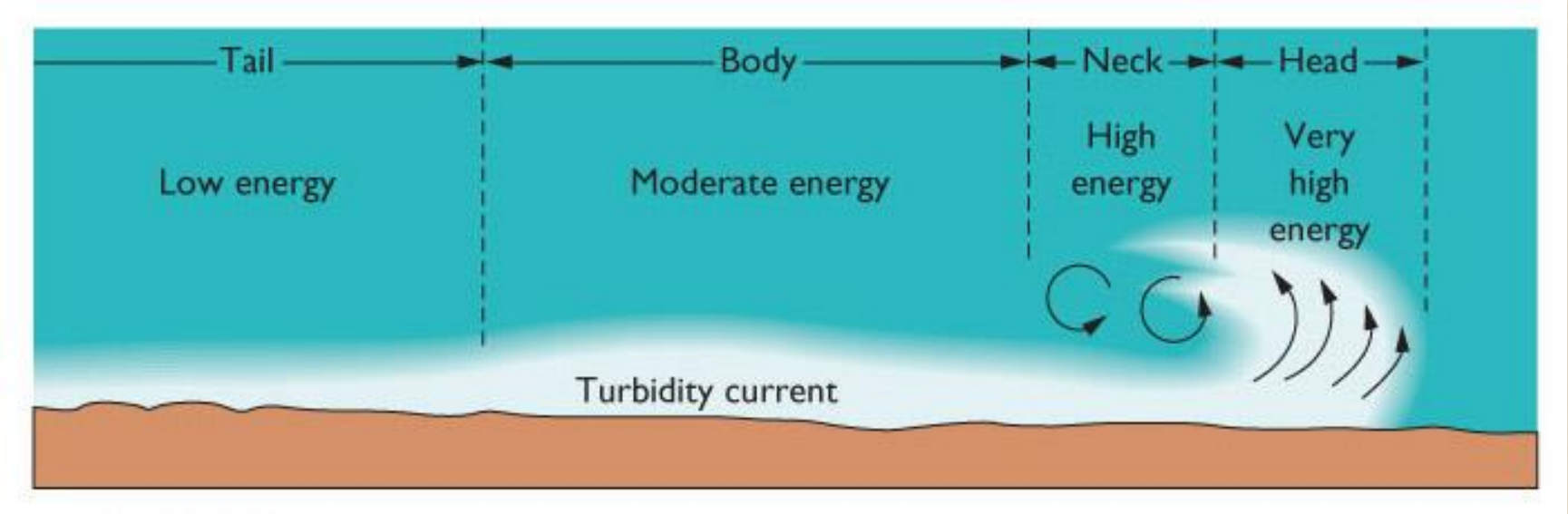


Figure 4-10b Turbidity Current

Figure 4-14b Foraminifera

Major pelagic sediments in the ocean are red clay and **biogenic oozes**.

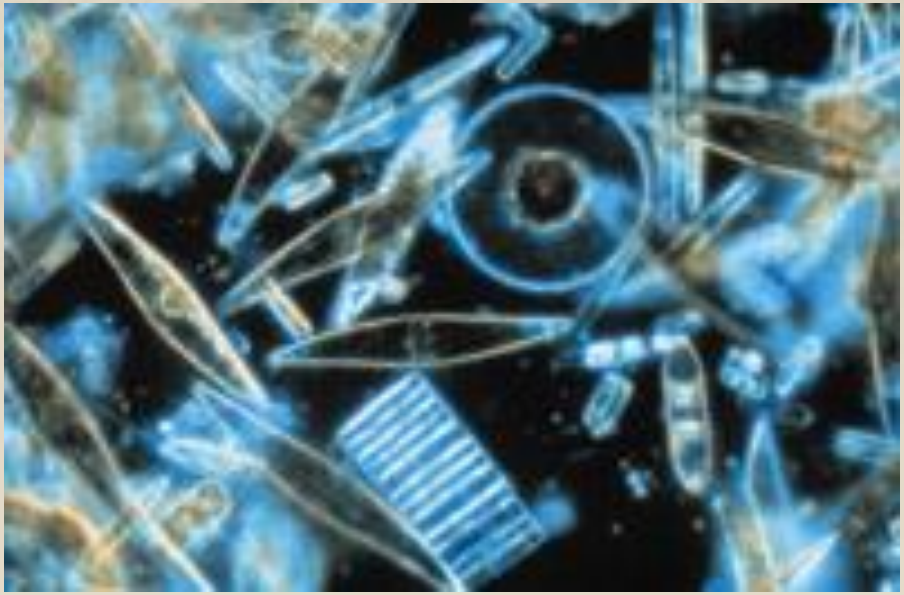
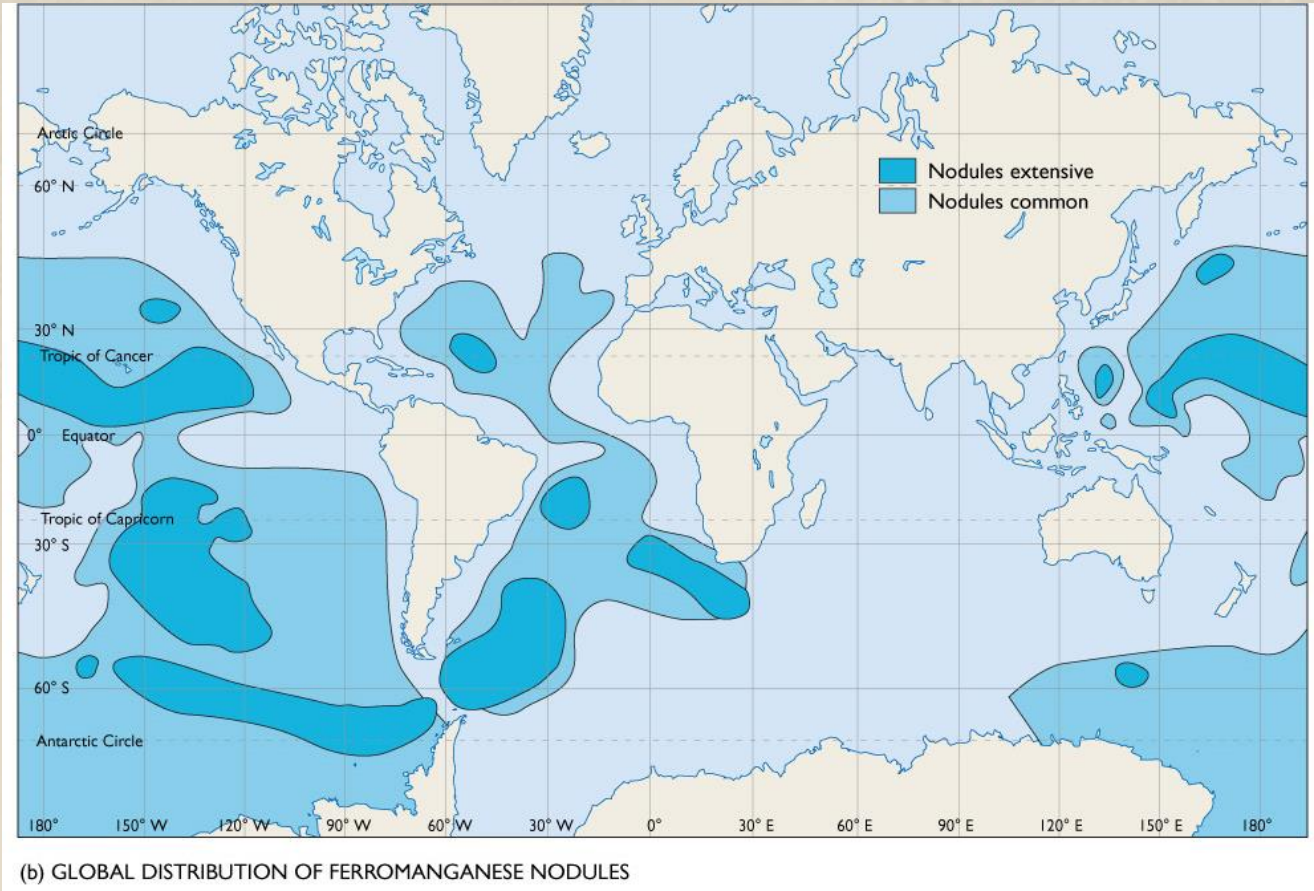


Figure 4-14e Diatoms

- Hydrogenous deposits are chemical and biochemical precipitates that form on the sea floor. They include:
  - ferromanganese nodules
  - phosphorite



(b) GLOBAL DISTRIBUTION OF FERROMANGANESE NODULES

Figure 4-15b Global Distribution of Ferromanganese Nodules

- The distribution of sediments in the deep ocean reflects:
  - Latitude
  - distance from landmasses
  - the calcium carbonate compensation depth

- Glacial marine sediments occur in the high latitudes.

- Pelagic clays occur far from land and in the deepest water.

The Formation of Glacial-Marine Sediments

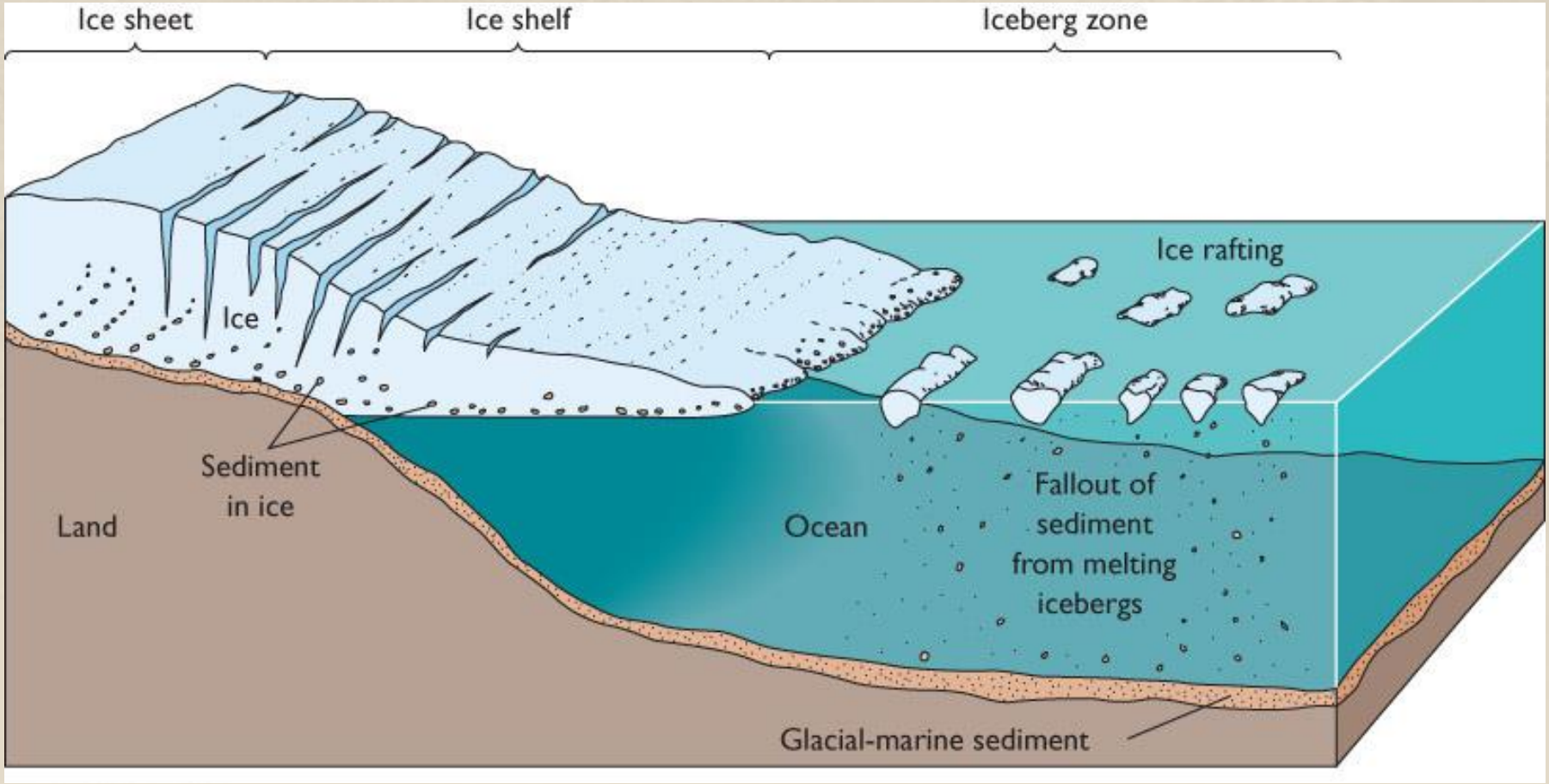


Figure 4-12a Ice Rafting

4-2 Sedimentation in the Ocean

The Formation of Glacial-Marine Sediments

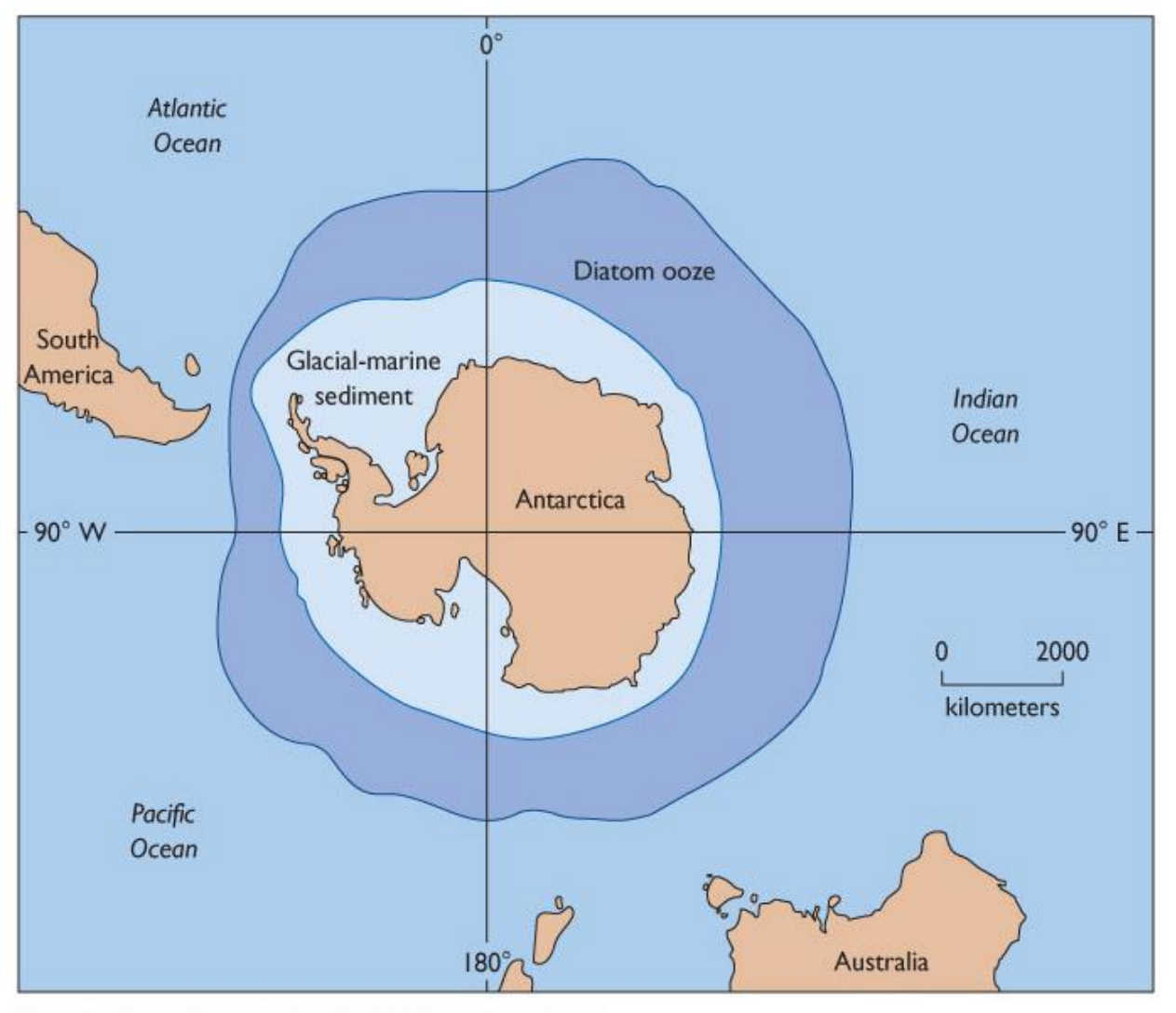


Figure 4-12b Deep-Sea Deposits Around Antarctica

Global Deep-Sea Deposits

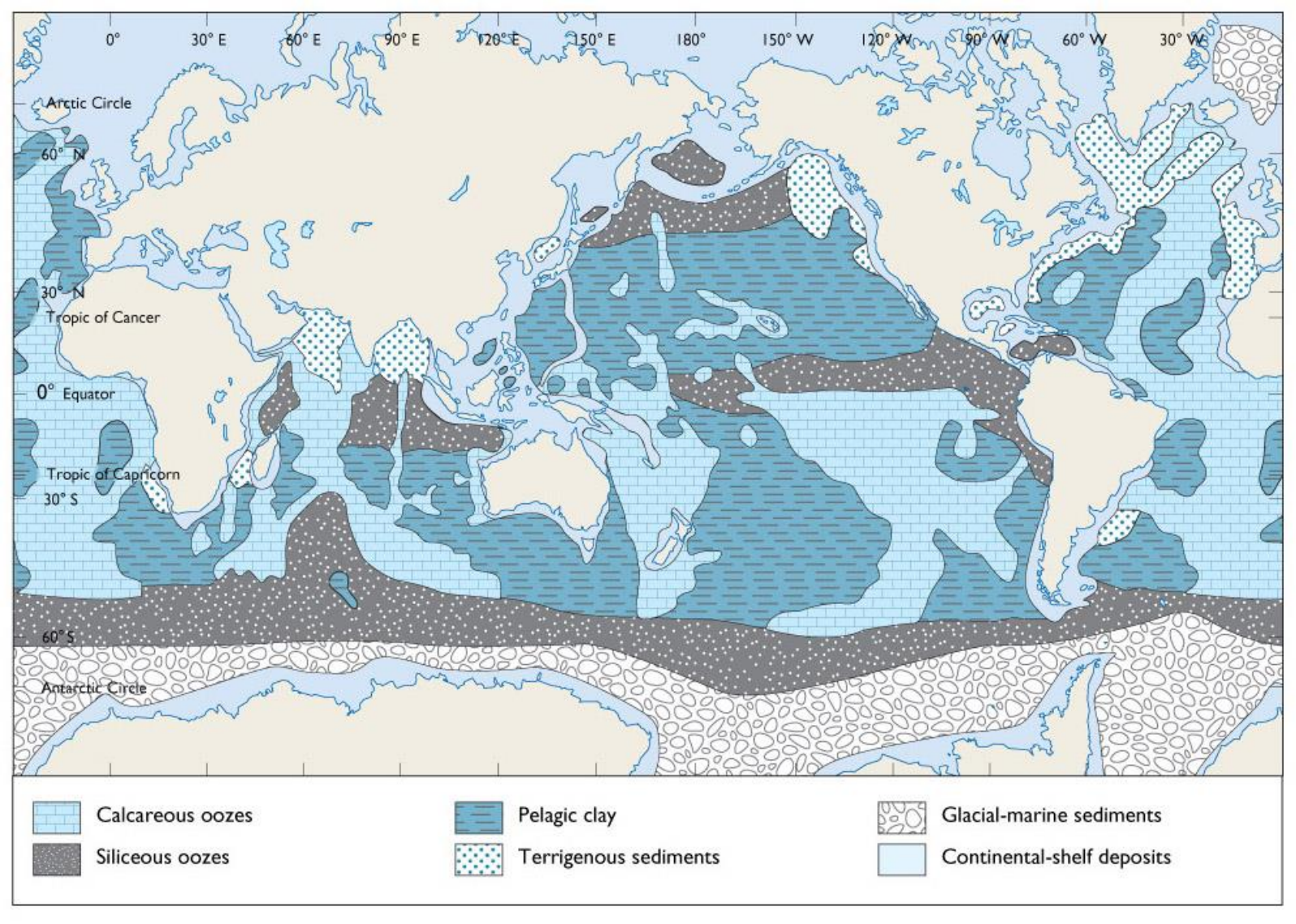


Figure 4-16a Deep-Sea Sediment Distribution

Global Deep-Sea Deposits

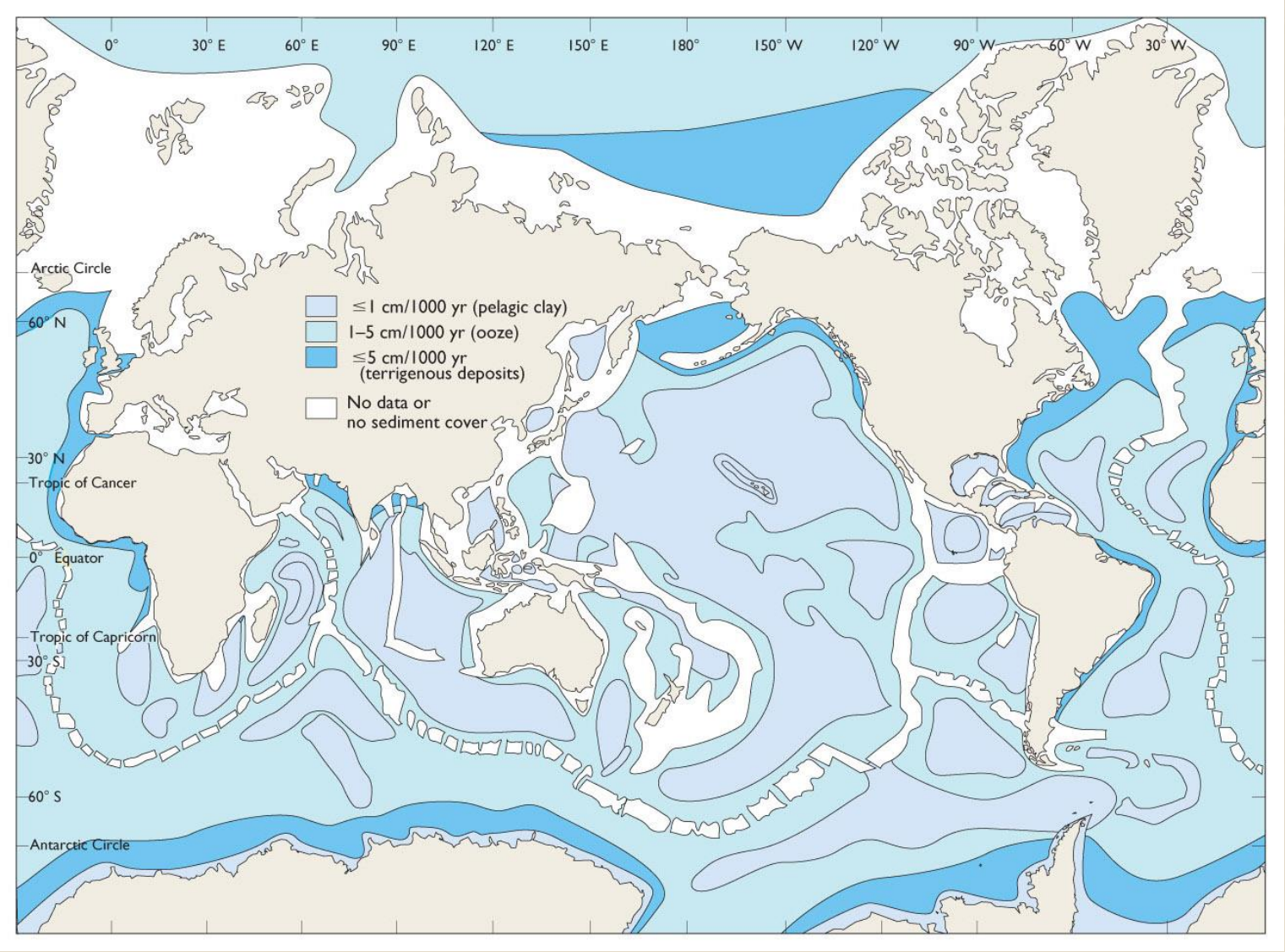


Figure 4-16b Sedimentation Rates

4-2 Sedimentation in the Ocean

- **Deep-sea stratigraphy** refers to the broad-scale layering of sediments that cover the basaltic crust.

- The stratigraphy of the deep sea is strongly influenced by sea-floor spreading.

- The Atlantic basin contains a “two-layer-cake” stratigraphy – a thick basal layer of carbonate ooze overlain by a layer of mud.

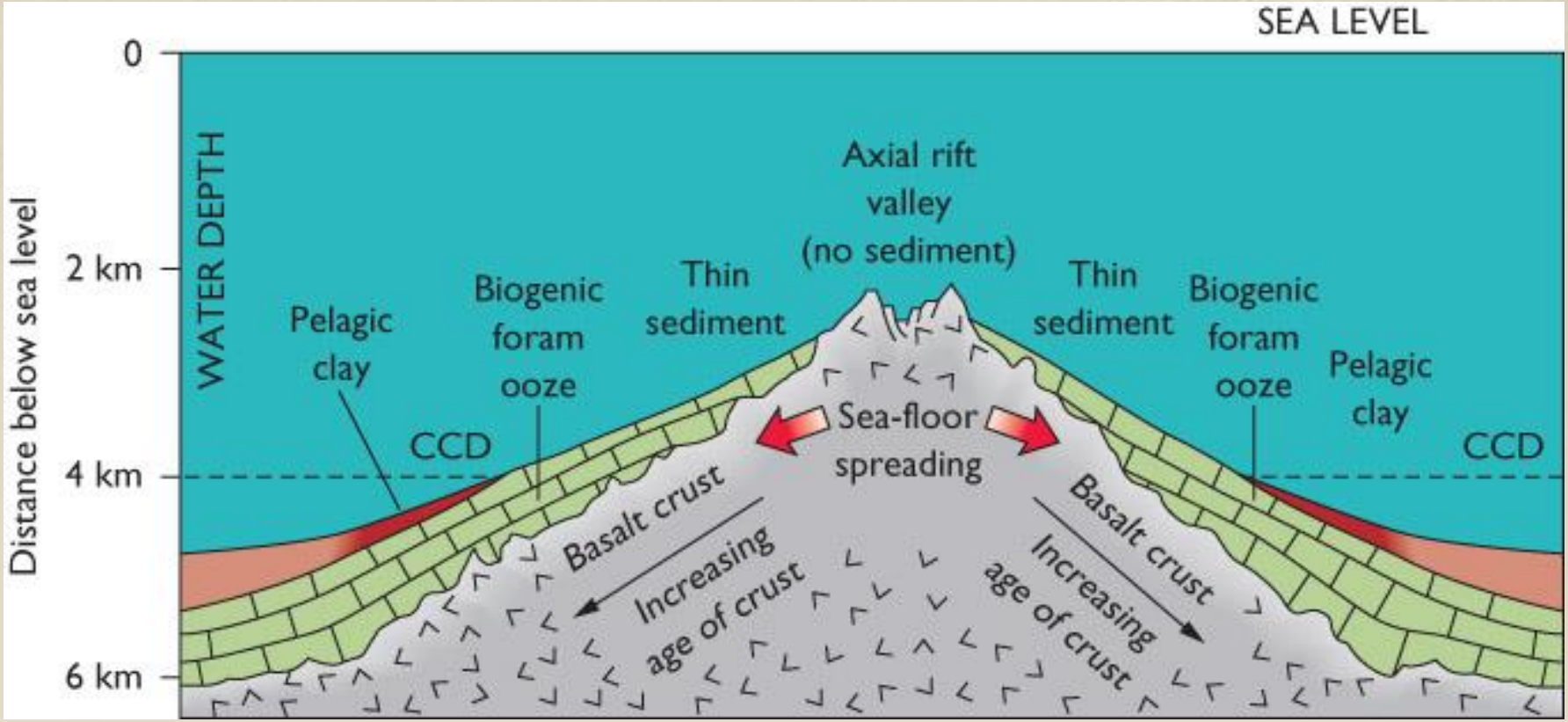


Figure 4-17 Stratigraphy of the Atlantic Basin

- The Pacific basin contains a “four-layer-cake” stratigraphy.
- It crosses the equator where the CCD is lowered to the ocean bottom.

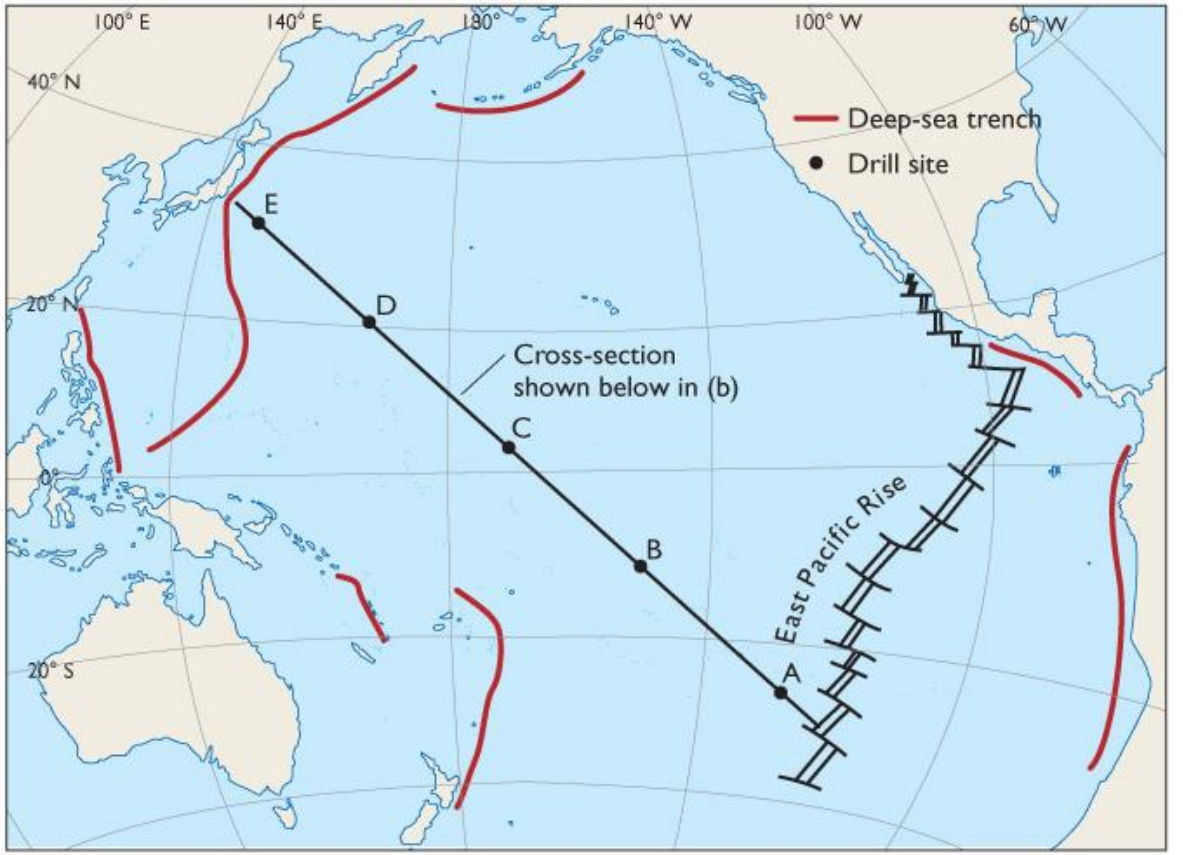


Figure 4-18a Pacific Ocean

Stratigraphy of the Pacific Basin

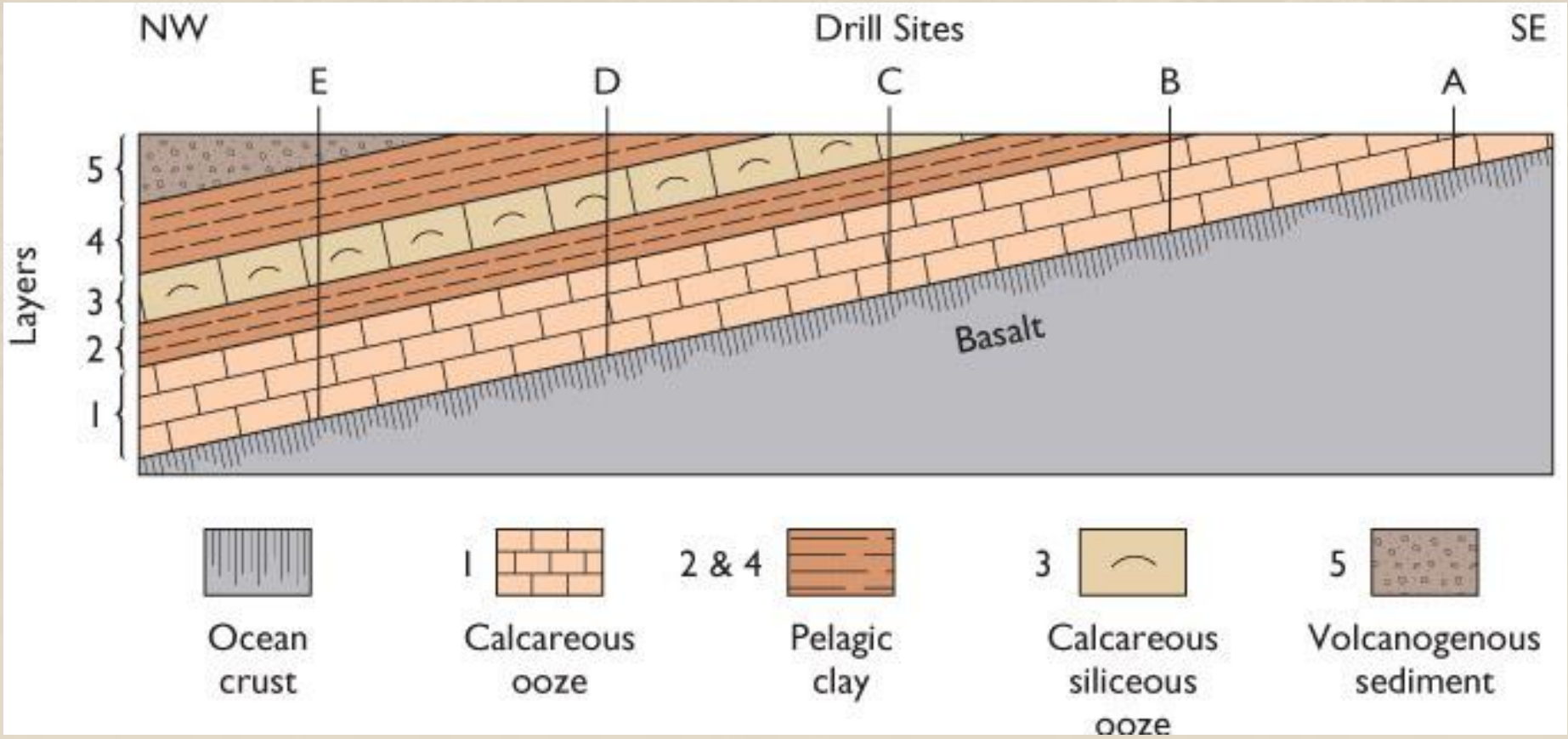


Figure 4-18b Stratigraphy of the Pacific Basin

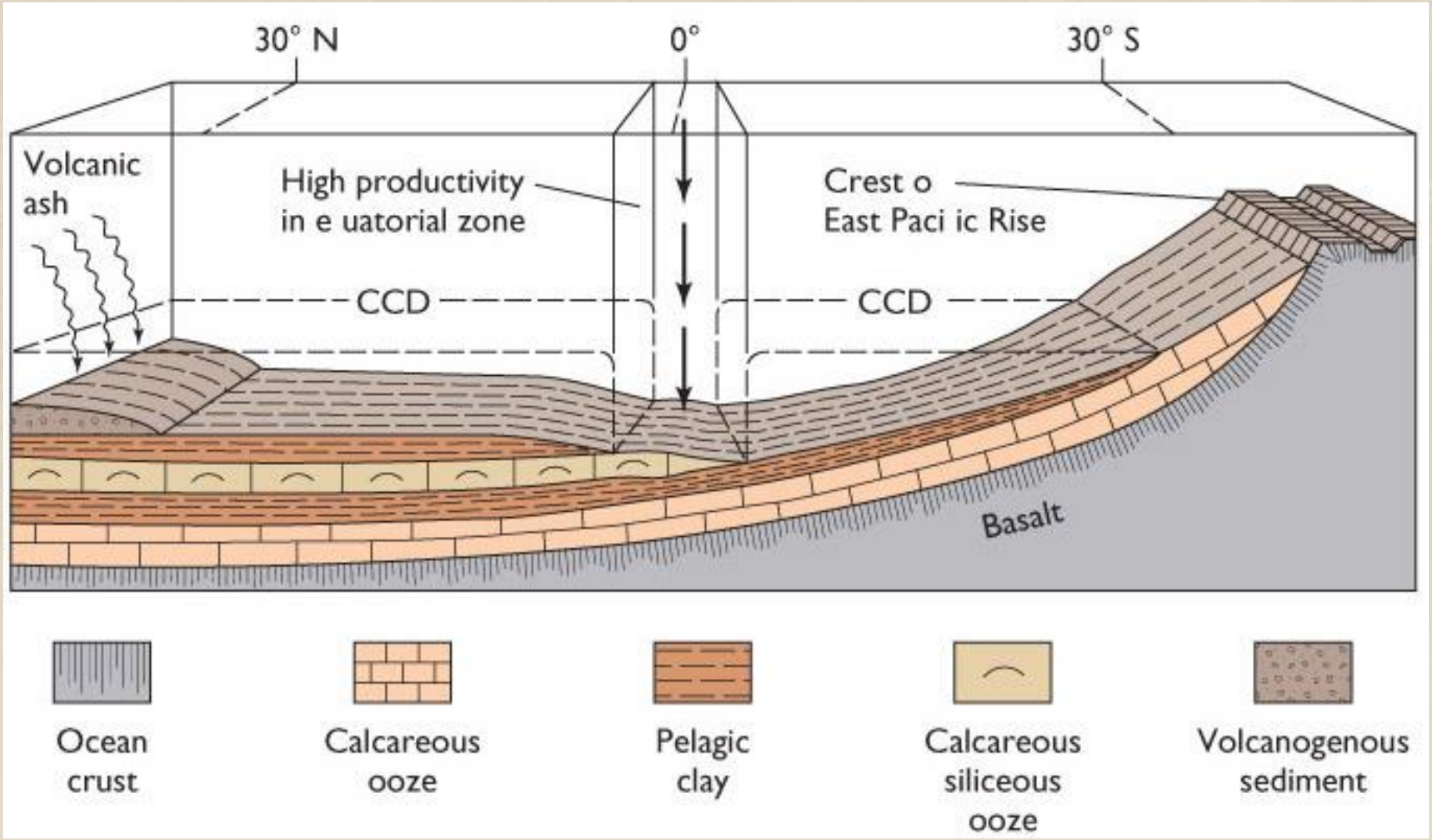


Figure 4-18c Model to Account for Pacific Stratigraphy