

Lecture Outlines PowerPoint

Chapter 12

Earth Science, 12e

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Earth Science, 12e

Earth's Evolution through Geologic Time Chapter 12



Birth of a planet

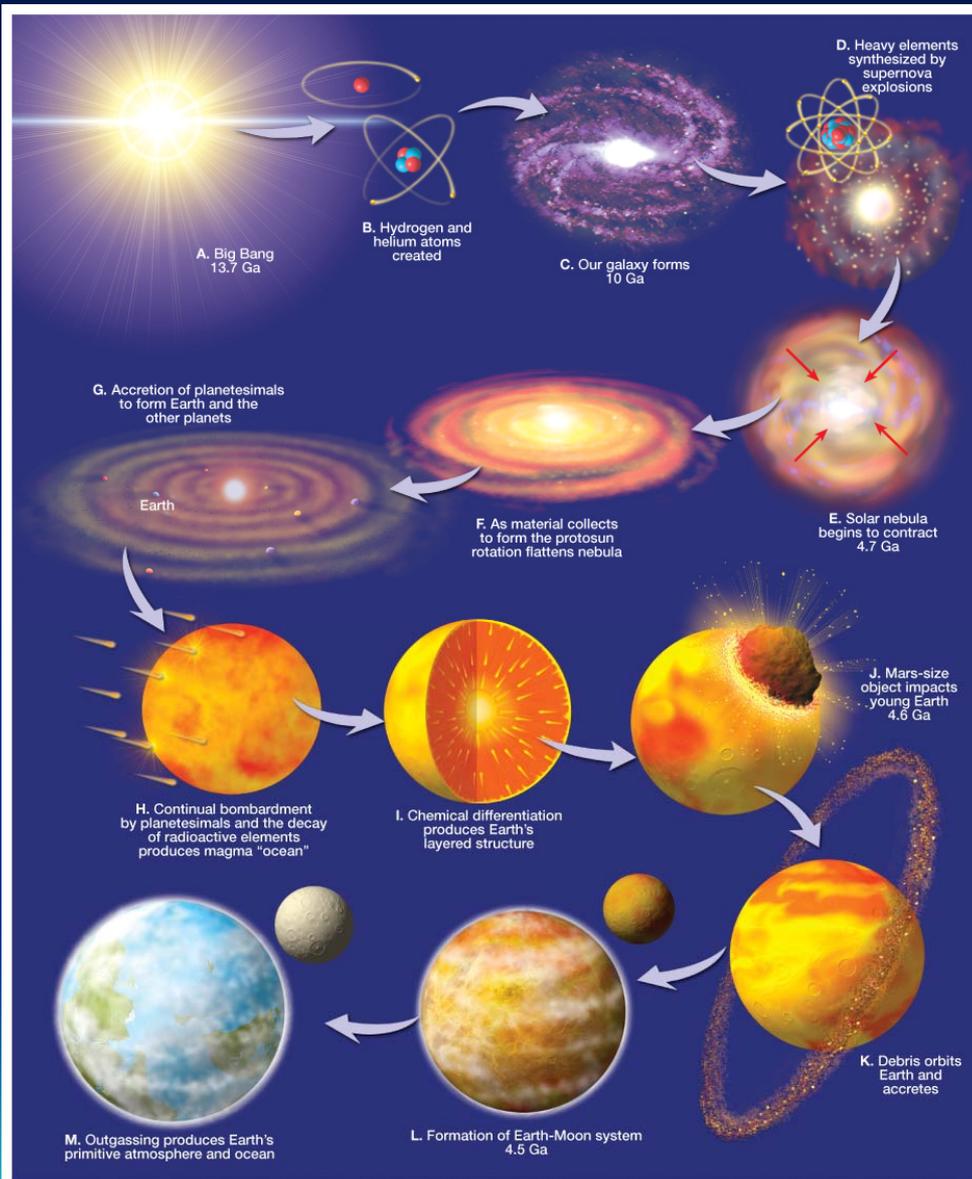
- The history of Earth began about 13.7 billion years ago with the Big Bang
- This provided the elements, along with material from former stars, to form the solar system
 - As material collected, high-velocity impacts of matter, called **planetesimals**, caused Earth's temperature to increase



Birth of a planet

- **Formation of Earth**
 - **Iron and nickel melted and sank to form the metallic core while rocky material rose to form the mantle and Earth's crust**





Formation of the early Earth

Figure 12.5

Origin of the atmosphere and oceans

- Earth's primitive atmosphere, which consisted mainly of H₂O vapor and CO₂, formed by a process called **outgassing**
 - Gases trapped in the planet's interior are released by volcanic eruptions
 - This process continues today



Origin of the atmosphere and oceans

- **Water vapor condensed to form clouds and rainwater that formed the oceans**
- **About 3.5 billion years ago, photosynthesizing bacteria began to release oxygen**
 - **Oxygen levels steadily increased over time**
 - **Eventually oxygen levels were sufficient for ozone to develop in the atmosphere**



Origin of the atmosphere and oceans

- **Outgassing produced acidic conditions that caused an accelerated rate of weathering of Earth's rocky surface**
 - **Products of this weathering were carried to the oceans, thus increasing the salinity of the oceans**
 - **Oceans also served as a depository for carbon dioxide**



Precambrian history

- The Precambrian, which is divided into the **Archean** and the **Proterozoic** eons, spans almost 90% of Earth's history
 - Much of Earth's stable continental crust was created during this time
 - Partial melting of the mantle formed volcanic island arcs and ocean plateaus
 - These crustal fragments collided and accreted to form larger crustal provinces



Precambrian history

- The Precambrian, which is divided into the **Archean** and the **Proterozoic** eons, spans almost 90% of Earth's history
 - Much of Earth's stable continental crust was created during this time
 - Larger crustal areas were assembled into larger blocks called **cratons**
 - Cratons form the core of modern continents



Formation of continental crust

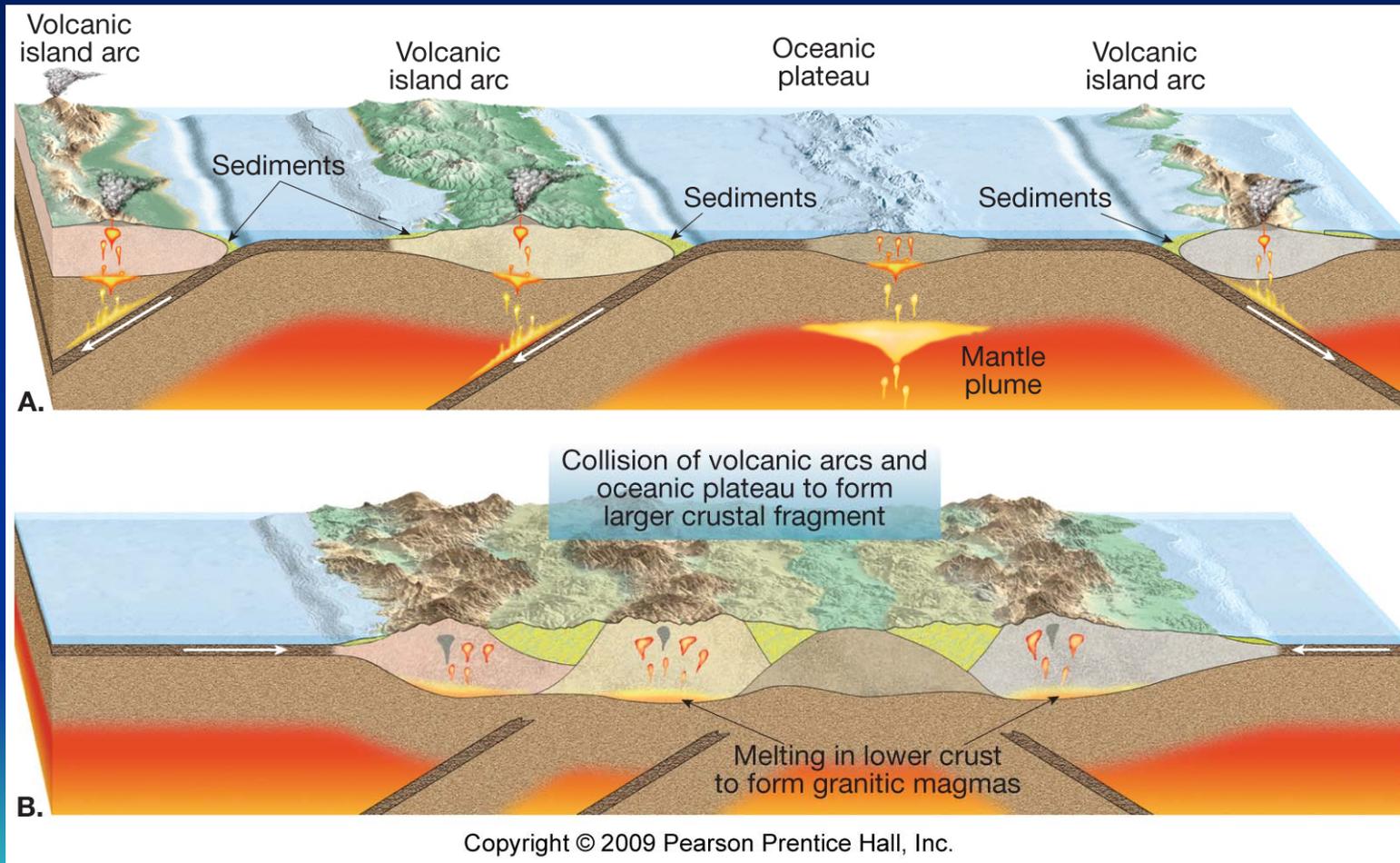


Figure 12.12

Precambrian history

- **Supercontinents**
 - Large landmasses that consist of all, or nearly all, existing continents
 - **Pangaea** was the most recent, but perhaps an even larger one, **Rodinia**, preceded it
 - Splitting and reassembling of supercontinents have generated most of Earth's major mountain belts
 - Supercontinents have also profoundly affected Earth's climate over time



Possible configuration of Rodinia



Figure 12.15

Phanerozoic history

- Phanerozoic eon encompasses 542 million years
 - Divided into the **Paleozoic**, **Mesozoic**, and **Cenozoic** eras
- **Paleozoic era**
 - Dominated by continental collisions as Pangaea began to assemble
 - Formed the Caledonian, Appalachian, and Ural Mountains



Formation of Pangaea



Figure 12.19 D

Phanerozoic history

- **Mesozoic era**
 - Early in the Mesozoic, much of the land was above sea level
 - By the middle Mesozoic, seas invaded western North America
 - Pangaea began to break apart and the westward-moving North American plate began to override the Pacific plate



Phanerozoic history

- **Mesozoic era**
 - Pangaea began to break apart and the westward-moving North American plate began to override the Pacific plate
 - Resulted in crustal deformation along the entire western margin of North America
 - Formed the Sierra Nevada and Rocky Mountains



Phanerozoic history

- **Cenozoic era**
 - **Much of North America was above sea level throughout the Cenozoic**
 - Eastern and western margins of the continent experienced markedly contrasting events
 - Atlantic and Gulf coastal regions, removed from active plate boundaries, were tectonically stable



Phanerozoic history

- **Cenozoic era**
 - Much of North America was above sea level throughout the Cenozoic
 - In the West, the Laramide orogeny (Rocky Mountains) was ending, the Basin and Range Province was forming, and volcanic activity was extensive



Earth's first life

- First known organisms were single-celled bacteria, **prokaryotes**, which lacked a nucleus
 - One group of prokaryotes, called **cyanobacteria**, used solar energy to synthesize organic compounds, thus producing their own food
 - Fossil evidence of these bacteria include layered mounds called **stromatolites**



Paleozoic era: Life explodes

- **Paleozoic marks the first appearance of life-forms with hard parts such as shells**
 - **Resulted in abundant Paleozoic fossils**
 - **Life in the early Paleozoic was restricted to the seas and consisted of several invertebrate groups including**
 - **Trilobites**
 - **Cephalopods**
 - **Sponges**
 - **Corals**



Paleozoic marine invertebrates



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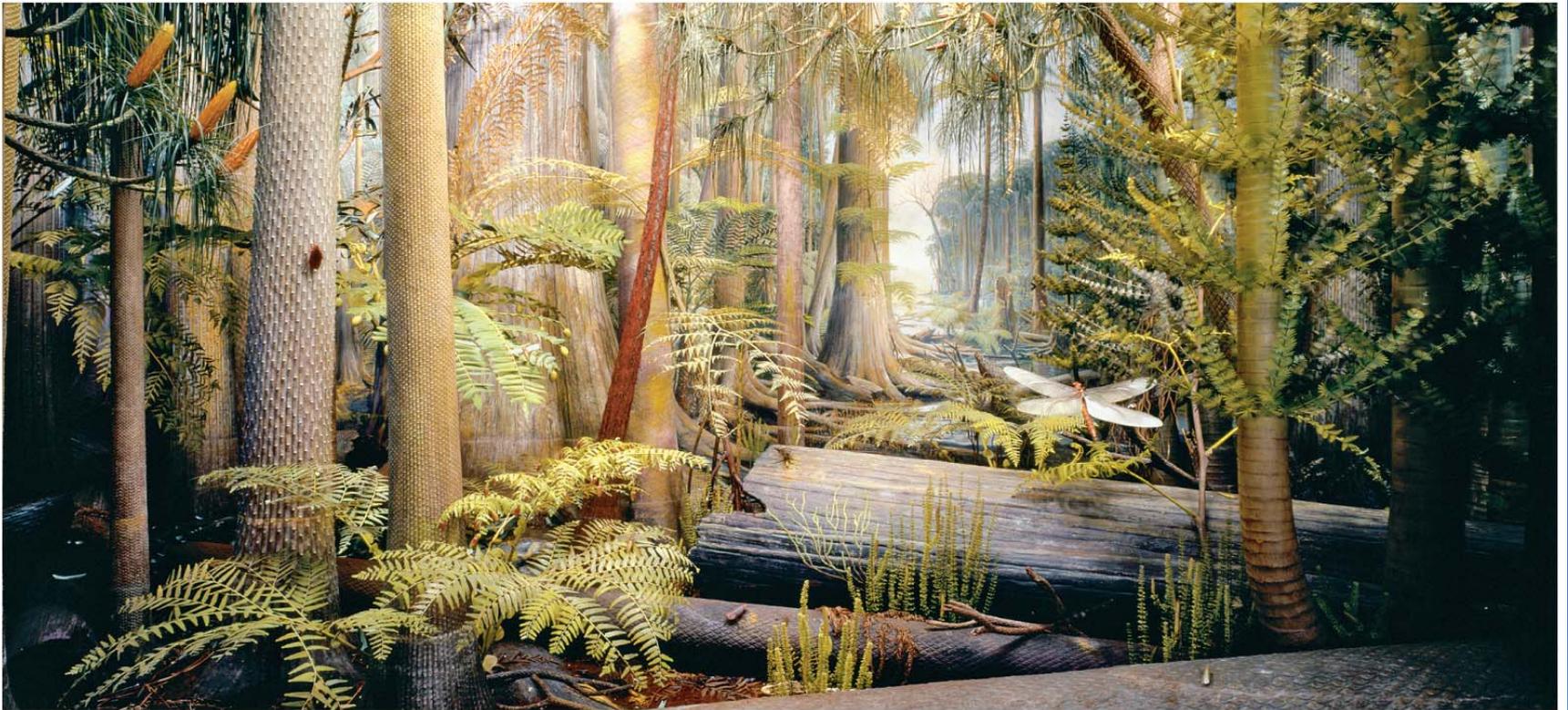
Figure 12.26

Paleozoic era: Life explodes

- **During the Paleozoic, organisms diversified dramatically**
 - **Insects and plants moved onto land**
 - **Lobe-finned fishes adapted to land and became the first amphibians**
 - **Large tropical swamps in the Pennsylvanian period became the major coal deposits of today**



Pennsylvanian-age coal swamp



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Figure 12.29

Paleozoic era: Life explodes

- **During the Paleozoic, organisms diversified dramatically**
 - **A mass extinction at the close of the Paleozoic destroyed 70% of all vertebrate species on land and 90% of all marine organisms**



Mesozoic Era: Age of the dinosaurs

- Mesozoic, literally the era of middle life, is often called the “Age of Reptiles”
 - Organisms that survived the extinction at the end of the Paleozoic began to diversify
 - **Gymnosperms** (cycads, conifers, and ginkgoes) became the dominant trees of the Mesozoic
 - Reptiles became the dominant land animals
 - First reptiles were small, but evolved rapidly, particularly the dinosaurs



Mesozoic Era: Age of the dinosaurs

- Mesozoic, literally the era of middle life, is often called the “Age of Reptiles”
 - Organisms that survived the extinction at the end of the Paleozoic began to diversify
 - Diversity of reptiles included large carnivorous dinosaurs, even larger herbivorous dinosaurs such as **Apatosaurus**, pterosaurs or flying reptiles, and **Archaeopteryx**, the predecessor of modern birds



Archaeopteryx fossil



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Figure 12.32

Mesozoic Era: Age of the dinosaurs

- **Mesozoic, literally the era of middle life, is often called the “Age of Reptiles”**
 - **At the close of the Mesozoic, many reptile groups became extinct**
 - **A few types survived, including the turtles, snakes, and lizards**



Cenozoic Era: Age of mammals

- In the Cenozoic, mammals replaced the reptiles as the dominant vertebrate life-forms on land
 - Two groups evolved, the **marsupials** and the **placentals**
 - One tendency was for some mammal groups to become very large
 - Late Pleistocene extinctions eliminated these larger animals



Cenozoic Era: Age of mammals

- The Cenozoic could also be called the “Age of Flowering Plants”
 - Flowering plants (**angiosperms**) strongly influenced the evolution of both birds and herbivorous mammals throughout the Cenozoic



End of Chapter 12

