Outline 13: The Paleozoic World

Shallow marine and terrestrial facies

Shallow marine facies

- Sea level was much higher than today during much of the Paleozoic.
- Shallow epicontinental seas flooded continental interiors.
- Rocks with marine fossils are common in the centers of continents.
- Beach deposits like Seneca Rocks are also common.
History of Sea Level Change. Sea Level today is low compared to the overall record.

Devonian Paleogeography

Barrier Islands, bays, and continental shelf on the New Jersey coast.
Devonian Paleogeography

Sedimentary wedges associated with orogenic events

Seneca Rocks, WV – Paleozoic barrier island deposits; folded and turned on end.
Seneca Rocks is a limb of the Wills Mountain Anticline in eastern WV
Coal Deposits

- Most of the world’s coal deposits formed during the Carboniferous. Why?
- Woody plants evolved in the Devonian. These are the plants that form coal.
- Carbon dioxide levels were 10X higher in the early Paleozoic.

**CO₂ falls as coals form**

Coal Deposits

- Carbon dioxide levels were reduced to modern levels by the end of the Paleozoic.
- What happened to all that CO₂?
- The carbon was converted to wood, then to peat, then to coal. The oxygen was released to the atmosphere.
Chemical Formulas

- Photosynthesis:
  \[ 6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 \text{ (sugar)} + 6O_2 \]
- Sugar forms cellulose or wood:
  \[ C_6H_{10}O_5 \text{ (cellulose)} + H_2O \]
- Wood changes to peat, lignite, bituminous coal, and anthracite under heat and pressure:
  \[ C_6 \text{ (coal)} + 5H_2O \]
- Anthracite is almost pure carbon

Oxygen and CO₂ levels during the Phanerozoic

- PAL = Present Atmospheric Level of Oxygen
- \( R \) = ratio of CO₂ to present day level

Paleozoic
- Mesozoic
- Cenozoic

Coal Deposits

- Did extensive coal ever form again?
- CO₂ levels increased again in the Cretaceous and the early Cenozoic, the only other times of significant coal formation.
- Very little coal is forming today.
The Nile Delta. Shaped like the Greek letter delta.

The Mississippi River delta
A meandering stream with a sandy point bar on the inside curve, and a cut bank on the outside curve. The point bar dips toward the stream channel.

Pennsylvanian point bar deposits on WV Rt. 19 near Fayetteville.

A modern swamp in Louisiana
Model for Pennsylvanian coal formation

Carboniferous forest with scale trees
**Lycopodium**, descendant of scale trees

**Figure 13.7:**
A. **Lycopodium** fossilization; B. **Lycopodium** fossil in Wyoming coal mine.
Upper Freeport Coal with overlying fluvial sandstones deposited by meandering river.

Coal outcropping in Morgantown. Can be up to 10 ft. thick.

Coal Mining Methods
Underground mine. Limestone dust sprayed on the coal to reduce coal dust.

Underground Machines

Longwall Shearer

Continuous Miner

Mountain top removal – it ain’t pretty
Drag Line on Mountaintop Mine

These are big shovels

Final Reclamation
Cyclothems

- Cyclothems are cyclic sequences of marine and nonmarine facies. The facies are repeated. Counted by coals.
- Repeated fluctuations of sea level produced the cyclothems.
- Sea level fluctuations associated with fluctuating glaciers on Gondwana.

Cyclothems

- There are about 50 cyclothems in the Illinois Coal Basin. These are tied to worldwide changes in sea level.
- There are about 90 cyclothems in the WV Coal Basin. The extra 40 were caused by delta shifting as rivers changed courses.

Rapid fluctuations in sea level during the Pennsylvanian as ice volumes at the South Pole expanded and contracted.
One cyclothem: cycles from nonmarine to marine

Pennsylvanian Cyclothems in Kentucky – count the coals

Pennsylvanian rocks of the Pittsburgh Fm. on I-79 near Carnegie, PA. White rocks are freshwater limestones formed in lakes.
Cyclothsms are created by alternating transgression and regression of epicontinental seas.

Delta Shifting on the Mississippi Delta. Delta shifting can form local cyclothsms.

A modern marine transgression is exposing Holocene peat deposits on the Louisiana coastline. This transgression is caused by subsidence associated with delta shifting.
Model of coal formation for Pennsylvania cyclothsems.

U.S. Coal Production

- Wyoming is #1 overall in tonnage. Coal is sub-bituminous, and low in sulfur.
- West Virginia is #2 overall, but #1 east of the Mississippi River. Coal is bituminous and has 3X more BTUs than Wyoming coal, but is higher in sulfur.

Coalfields of the United States