

GLY1010 Introduction to Earth Sciences

Lecture 7: Sedimentary Rocks

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Reading: Ch 7 pg. 211- 241

Ch 21 pg 625-629

Cell Phones Off

Sedimentary Rocks

- Form from the deposition of *sediments*
- <10% of Crustal Volume
- Cover 75% of surface area of continents
- Deposited in layers (stratified)
 - record sequence of history
- They often contain fossils - history of life recorded in sedimentary rocks → Ch 9
- Sedimentary rocks contain important energy resources (fossil fuels)

Sedimentary Processes in the Rock Cycle

- Weathering and Erosion of parent rock into smaller fragments (sediments) or dissolved ions
 - Detrital (Clastic) sediments
 - Chemical Sediments
- Transportation of the sediments to the site of deposition
- Deposition and burial
 - Sedimentary Environments
- Diagenesis
 - Alteration/ recrystallization of sediments
 - Lithification
 - » Compaction
 - » Cementation

Sediments

- Form through weathering of parent rock
- Detrital (clastic) sediments
 - Composed of fragments (*Detritus, Clasts*) from the mechanical breakdown of other rocks
- Chemical Sediments
 - Ions from chemical weathering dissolved in water
 - Minerals precipitate out of solution to form rock
 - Often form through biochemical processes: shell fragments, corals, skeletons
- 2 Basic Subdivisions of Sedimentary Rocks
 - Detrital
 - Chemical/Biochemical

Sediment Mineralogy

- Detrital Sediments
 - Reflect the degree of weathering of the parent rock
 - Ex: Granitic Parent rock:
 - » Quartz resistant to weathering
 - Quartz sand → Sandstone
 - » Feldspars weather to clay minerals
 - Clay, mud → shale
- Chemical Sediments
 - Originate as weathering products (Ca, K, Na, Cl, SO₄ ions)
 - Reflect the types of minerals formed from ions that are easily dissolved in water
 - » calcite, halite, gypsum

Sediment Mineralogy Versus Degree of Weathering

Granitic Source Rock

Degree of Weathering		
Low	Medium	High
Quartz Feldspar Mica Pyroxene Amphibole	Quartz Feldspar Mica Clay minerals SiO ₂ , Mg, Ca Ions	Quartz Clay minerals SiO ₂ , Mg, Ca, Na, K Ions

Transportation and Modification

- **Mechanisms: water, ice, wind, gravity**
 - Water transportation is most important
- **Sediments are further modified/weathered during transportation**
- **Final form (size, roundness) in rock reflects transportation distance**
 - Farther traveled clasts are more rounded by abrasion
 - Degree of roundness is an important indicator of the distance from the source
 - Farther traveled clasts are generally smaller due to sorting

Deposition (Sedimentation)

- **Detrital sedimentation is driven by gravity**
 - Occurs when currents are sufficiently small for the sediments to fall out of suspension
 - Sediments are often *Sorted*
- **Deposition of chemical and biochemical sedimentation are driven by chemistry**
 - Occur when environmental conditions are right for dissolved minerals to precipitate from solution, or when they are assembled by biological entities

Sorting and Sediment Size

- **Processes by which sediment particles of different sizes are deposited in different places**
- **Related to velocity or energy of water (or wind)**
- **General rules:**
 - the faster a fluid moves, the greater its capacity to move large or heavy sediments
 - Conversely, the slower a fluid moves, lesser its capacity to move large (or heavy) sediments
 - Particle size in stream beds decrease down stream, results in sorting (see Ch 16)
- **When sediments are poorly sorted, we know that they were transported by some unusual mechanism**
 - glaciers, landslides, turbidity currents

Detrital Sedimentary Environments

- **Continental**
 - **Alluvial:** alluvial fans, river channels, floodplains
 - » Gravels, sands, muds
 - **Lacustrine:** Lake conditions
 - » Sands, muds
 - **Desert:** Windblown (eolian) + alluvial; Dunes; Playa lakes
 - » Sands, dust
 - **Glacial:** Transport by Ice and melt water
 - » Till (poorly sorted gravels, sands, mud)

Detrital Sedimentary Environments(continued)

- **Shoreline**
 - Deltaic, tidal flat
 - » sands, muds
 - Beach or Shoreline: Transportation by wave action, high energy
 - » gravels, sands
- **Marine**
 - Continental shelf
 - » sands, muds
 - Continental margin: turbidity currents
 - » muds, sand
 - Deep sea: (pelagic)
 - » muds, shales

Chemical Sedimentary Environments

- **Shallow Carbonate:** shallow seas, lacustrine
- **Deep sea (pelagic)**
- **Evaporite**

Chemical Sedimentary Environments

- **Shallow Carbonate: shallow seas, lacustrine**
 - mostly biochemical (formed from CaCO_3 shells and secretions) from invertebrate animals and algae
 - Also from coral reefs (require clean warm water)
 - In some cases, carbonate minerals can precipitate directly from sea water --ooids: Bahamas, Pleistocene Florida
 - General conditions: warm, clean (silt free), shallow water
 - Thick sequences of carbonate rocks form *Carbonate Platforms*
 - » Ex: Florida (1000s km thick)

Chemical Sedimentary Environments (continued)

- **Deep sea (pelagic)**
 - Some carbonate rocks: planktonic shells (Foraminifera) which fall to the bottom
 - Some planktons form shells of silica (radiolarians, diatoms)
 - » form siliceous ooze on deep sea bottom
 - » chert (flint)

Chemical Sedimentary Environments (continued)

- **Evaporite:**
 - Ca, Na, K, Cl, CO_3 , SO_4 ions in solution
 - Form in warm environments where circulation of water is restricted (shallow enclosed lakes and seas)
 - » Loss of water by evaporation exceeds that of outflow
 - Solutions become supersaturated and minerals precipitate: CaCO_3 , $\text{CaSO}_4(2\text{H}_2\text{O})$ (gypsum), NaCl (halite)
 - The existence of evaporite rocks is evidence of a warm arid climate and shallow seas at the time of deposition

Classification of sedimentary rocks

- **Detrital rocks**
 - primarily classified by the size of the clasts (texture)
 - » Gravel (bolder, cobble, pebble) --> Conglomerate
 - » Sands (fine, medium, coarse) --> Sandstones
 - » Clays -> Shales
 - secondary classifications based on mineralogy
- **Chemical and Biochemical Rocks**
 - Primarily classified on mineralogy
 - » Carbonates (Limestone and Dolostone)
 - » Cherts
 - » Evaporites

Sedimentary Rock and Fossil Fuels

- **Fossil Fuels are always associated with sedimentary rocks**
- **Coal**
 - Organic material from swamps and bogs
- **Petroleum (Oil and Natural Gas)**
 - Formed from organic material in pore spaces between sediments
 - Generally associated with marine sedimentary rocks
 - » Continental shelves, river deltas
 - Source rocks are usually shales (Black Shales)
 - Reservoir rocks are usually sandstones and limestones

Selected Key Terms Sedimentary Rocks

- | | |
|------------------------------------|----------------------------------|
| • Bedding | • Sedimentary environment |
| • Biochemical | • Sorting |
| • Cementation | |
| • Chemical Sedimentary Rock | • Rocks to Know |
| • Clastic | - Breccia |
| • Compaction | - Chert |
| • Detrital | - Coal |
| • Diagenesis | - Conglomerate |
| • Evaporite | - Dolostone |
| • Fossil | - Rock Gypsum |
| • Lithification | - Limestone |
| | - Sandstone |
| | - Rock Salt |
| | - Shale |

Next Time:

- **Read Chapter 8: Metamorphic Rocks**
– Pg: 242-269