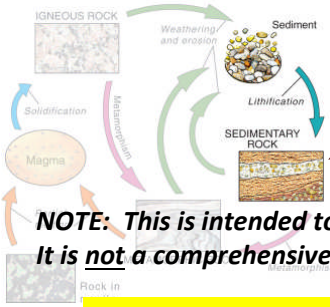
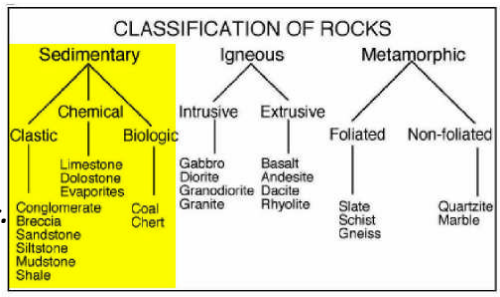


Sedimentary rocks in the Rock Cycle

Chapter Outlines



NOTE: This is intended to help students 'organize' their understanding of each topic. It is <u>not</u> a comprehensive study guide for quizzes or midterms, i.e. <u>study your text!</u>

Sedimentary Rocks

Sedimentary rocks cover about three-fourths of the surface of the continents. There are three kinds of sedimentary rocks: clastic, chemical, and organic. **Clastic** *(detrital)* **sedimentary rocks** form from consolidation of material such as gravel, sand, or clay *(sediment)* derived from the weathering and breakdown of rocks. **Chemical sedimentary rocks** result from biological or chemical processes, generally under water, that crystallize minerals which accumulate on the sea floor and from chemical precipitation. **Organic sedimentary rocks**, such as coal, have as their major component accumulations of organic remains from plants or animals that make the rock distinctive.

TABLE 6.1 Sediment Particles and Detrital Sedimentary Rocks

Diameter (mm)	Sediment		Sedimentary Rock
256	Boulder	Gravel	**Breccia** (angular particles) or **conglomerate** (rounded particles)
64	Cobble		
	Pebble		
2	Sand		**Sandstone**
1/16	Silt	"Mud"	Siltstone (mostly silt)
1/256	Clay		**Shale** or mudstone (mostly clay)

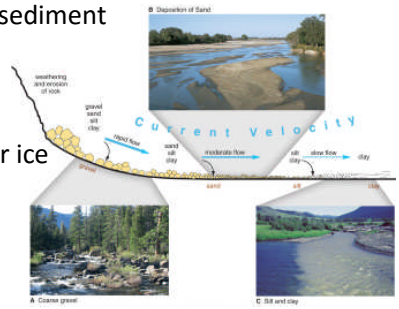
Sandstone and shale are quite common; the others are relatively rare.

Sediment

- **Sediment** - loose, solid particles originating from:
  - weathering and erosion of pre-existing rocks
  - chemical precipitation from solution
  - accumulation of the skeletal remains of small organisms

From Sediment to Sedimentary Rock **Source → slope → settle**

a. <u>S</u>ource *(weathering),* for most sediments is the weathering of a 'parent' rock
b. <u>S</u>lope *(transportation),* contributes to the erosion and transportation of sediment
c. <u>S</u>ettling *(deposition),* of the sediments takes place when they reach a low spot, transportation ceases and deposition occurs.

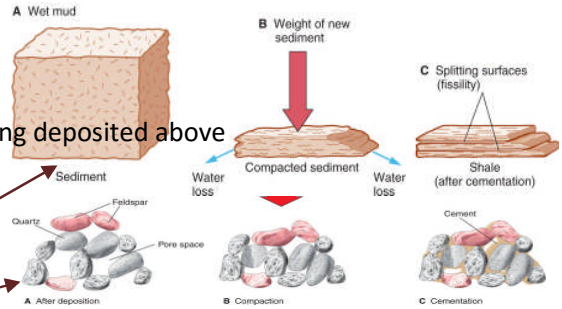


Erosion & transportation change to deposition as current slows

- **Erosion & Transportation**
  - movement of sediment away from its source, typically by water, wind, or ice
  - ***rounding*** of particles occurs due to abrasion during transport
  - ***sorting*** occurs as sediment is separated according to grain size by transport agents, especially running water
  - sediment size decreases with increased transport distance

'well sorted' when most grains are similar size

- **Deposition**
  - settling and coming to rest of transported material
  - accumulation of chemical or organic sediments, typically in water
- **Preservation –** sediment must be preserved, as by burial with additional sediments, in order to become a sedimentary rock
- **Lithification** of sediments *(turning into rock)*
  a. **<u>C</u>onsolidation** - Settling into layers of sediment
  b. **<u>C</u>ompaction** – by weight of more and more sediments being deposited above
  c. **<u>C</u>ementation** – by chemicals in the groundwater



Lithification of shale & of sandstone

Clastic Sedimentary Rocks

- Size classification is:
  - **Gravel** – grain size larger than 2mm
  - **Sand** – grains size is 1/16 to 2mm
  - **Silt** – grain size 1/256 to 1/16mm (feels gritty)
  - **Clay** – grain size less than 1/256mm (feels smooth)
- Cements *(by minerals in solution)*
  - Calcite – $CaCO_3$
  - Silica – SiO_2
  - Iron oxide – Fe_2O_3 *(less common)*
- **Conglomerate and Breccia**
  - ***coarse-grained clastic*** sedimentary rocks

Conglomerate – more rounded

Breccia – more angular

- **conglomerate** composed of ***rounded gravel***
- **breccia** composed of coarse, ***angular rock fragments***

- **Sandstone - medium**-grained *clastic* sedimentary rock. Types determined by composition:
  - ***quartz sandstone*** - >90% quartz grains
  - ***arkose*** - mostly feldspar, with quartz grains
  - ***graywacke*** - sand grains surrounded by dark, fine-grained matrix, often clay-rich
- **Siltstone** – slightly coarser-grained than shales; non-fissile
- **Shale** – fine-grained clastic sedimentary rock; ***fissile*** *(splits into thin layers)*
  - silt- and clay-sized grains
  - sediment deposited in lake bottoms, river deltas, floodplains, and on deep ocean floor
- **Mudstone** – silt and clay-sized grains; massive/blocky *("if you can't tell, just call it 'mudstone'!")*
- **Claystone** – predominantly clay-sized grains; non-fissile

Chemical Sedimentary Rocks

- **Carbonates** - calcites predominate. Examples:
  - **Limestone** - calcite, $CaCO_3$; precipitated directly from seawater, or accumulated organisms
  - **Dolomite** *(or Dolostone)* - $CaCO_3$with some Mg
  - **Chalk** - $CaCO_3$

A 'limestone' made up of shell fragments, also called Coquina

- **Siliceous -** hard, compact, fine-grained, formed almost entirely of silica. Examples:
  - **Diatomite -** silica, SiO_2; from microscopic skeletons
  - **Chert -** silica, SiO_2; mainly from animals, then re-crystallized
- **Evaporites** – form from evaporating saline waters *(lakes, oceans).* Examples are:
  - **Rock salt** – halite, NaCl; precipitated
  - **Rock gypsum** - $CaSO_4 \cdot 2H_2O$; precipitated
  - **Travertine -** $CaCO_3$; precipitated in caves or as tufas

The Dead Sea is an active evaporite environment

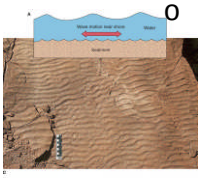
Evaporites on a desert playa

Organics in Sedimentary Rocks

- **Coal** – sedimentary rock forming from compaction of partially decayed plant material
  - **Peat** *(carbon)* → **Lignite** *(carbon)* → **Bituminous coal** *(carbon)* → **Anthracite coal** *(metamorphic) (carbon)*
- **Oil and natural gas**
  - originate from organic matter in marine sediment
  - subsurface 'cooking' can change organic solids to oil and natural gas
  - can accumulate in porous overlying rocks as it ascends through the overlying sedimentary beds

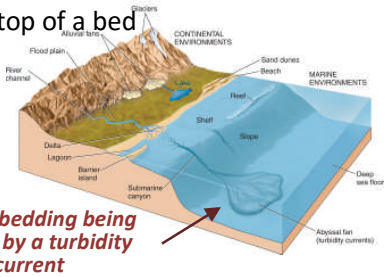
Sedimentary Structures - features within sedimentary rocks produced during or just after settling

- **Bedding -** the most common sedimentary structure
  - series of visible layers within a rock
- **Cross-bedding** – common in sandstone
  - series of thin, inclined layers within a horizontal bed of rock
  - indicative of deposition in ripples, bars, dunes, deltas
- **Ripple marks** - small ridges formed on surface of sediment layer by moving wind or water
- **Graded bedding –** progressive change *(decrease)* in grain size from bottom to top of a bed
- **Mud cracks -** polygonal cracks formed in drying mud
- **Fossils**
  - traces of plants or animals preserved in rock
  - hard parts *(shells, bones)* more easily preserved as fossils



Ripple marks

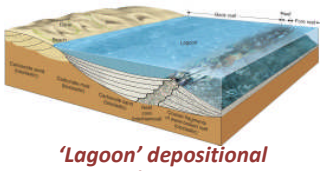
Cross-bedding In sandstone →



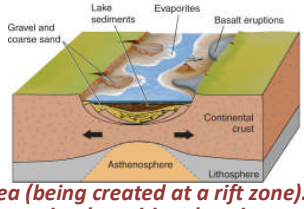
Graded bedding being formed by a turbidity current

Sedimentary Rock Interpretation - Sedimentary rocks give important clues to the geologic history of an area

- **Source area** - locality that eroded and provided sediment
  - sediment composition, shape, size and sorting are indicators of source rock type and relative location
- **Depositional environment - l**ocation where sediment came to rest. Examples:
  - **Terrestrial -** rivers, alluvial fans, Lakes, swamps, deserts, glacial, River channels and flood plains, dunes
  - **Marine - c**ontinental shelf, continental slope & rise, abyssal plain, reefs
  - **Transitional –** beaches, barrier islands, delta, lagoons, estuaries



'Lagoon' depositional environment



Inland sea (being created at a rift zone). A likely evaporite depositional environment