Sediment and Sedimentary rock

Sediment: An accumulation of loose mineral grains, such as boulders, pebbles, sand, silt or mud, which are not cemented together.

- Mechanical and chemical weathering produces the raw materials for soil and sedimentary rock.
- Sediment may be detrital or chemical, and sedimentary rocks may form by the deposition of particles or by biologic activity.
- Sediment can be carried a considerable distance from its source, eventually coming to rest in a depositional environment: (Continental , Transitional , Marine).

Sedimentary rock: Rock that forms either by the cementing together of fragments broken off preexisting rock or by the precipitation of mineral crystals out of water solutions at or near the Earth's surface.

- Sedimentary rocks make up only about 5% of the Earth's crust. As a result, sedimentary rocks cover about 75% of continents.
- Many sedimentary rocks have high economic value. Oil and gas form in certain sedimentary rocks.

Significance of sedimentary rocks:

- Cover more than 80% of the Earth's surface but they are less than 1% of the Earth's mass.
- Provide a record of ancient tectonic events (e.g., mountain building and erosion).
- Fossil record-evolution of life.
- Major reservoirs of groundwater, oil, coal.
- History of past climate changes.

The major processes forming the clastic sedimentary rocks:

1. ***Weathering:*** Transform the solid rock into smaller fragments
2. ***Transportation:*** Transport the sediments by sliding down slopes, being picked up by the wind, or by being carried by running water in streams, rivers, or ocean currents.
3. ***Deposition:*** Sediment is deposited when the energy of the transporting medium becomes too low to continue the transport process.
4. ***Lithification (Diagenesis):*** Lithification is the process that turns sediment into rock.

Physical or Mechanical Weathering:

The process in which a rock breaks into smaller grains or pieces called detritus (disintegration, i.e. without change in its chemical composition).

Many different phenomena contribute to physical weathering such as:

Jointing – Exfoliation – Frost wedging – Root wedging, Salt wedging – Diurnal temperature change, Thermal expansion – Animal attack

Chemical weathering:

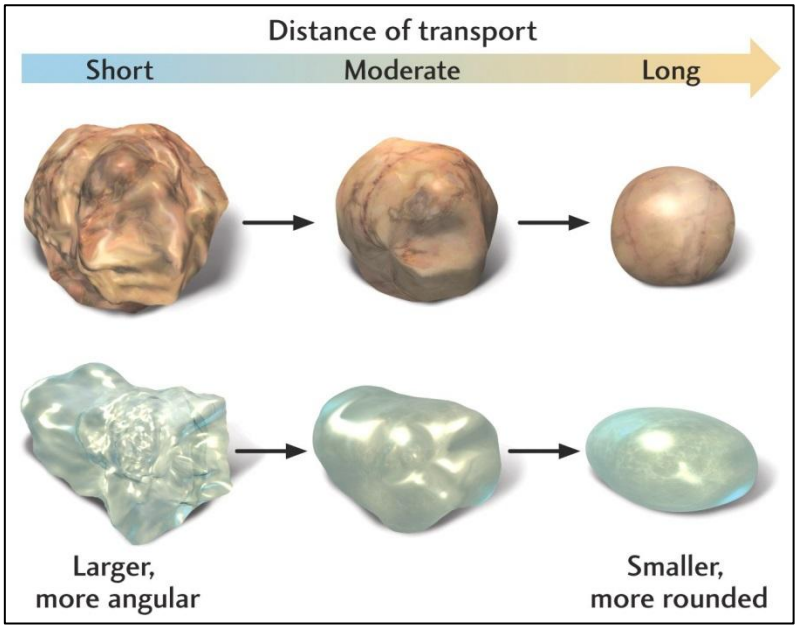
The process in which chemical reactions alter or destroy minerals (i.e. decomposition) when rock comes in contact with water solutions and/or air. It involves many processes such as:

Dissolution – Hydrolysis – Oxidation – Hydration

Water / Wind Transport:

- Currents carry sediment where current velocity, grain size and grain density control the sediment load
  - **Fast currents:** carry all sizes up to a maximum size
  - **Slow currents:** carry only small particles
- Rivers typically change from fast to slow along length, thereby depositing **sorted** material along its length
- Finer material reaches the oceans, builds deltas, with the very finest material carried out to deeper parts of the ocean

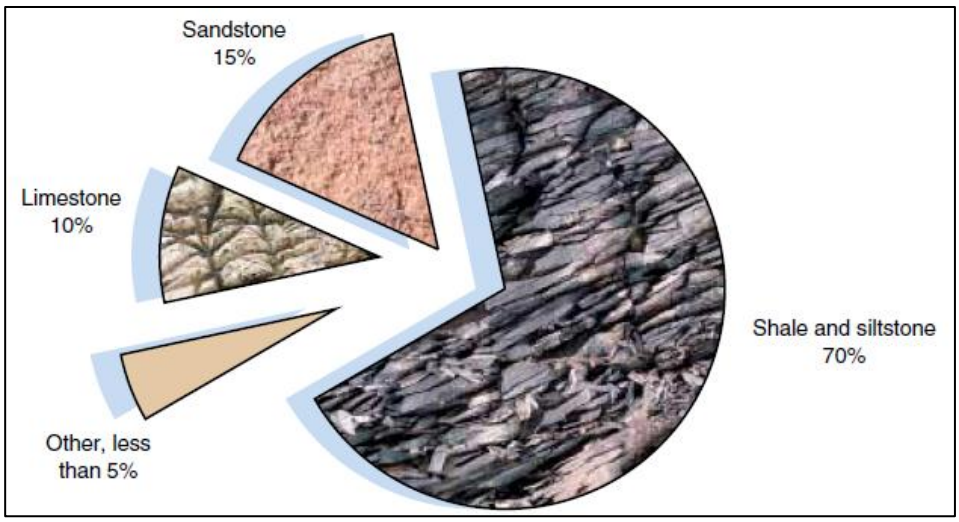
Rounding-tells us about distance and agent of transport:



Type of the Sedimentary Rocks:

Sedimentary rocks are broadly divided into four categories:

1. **Clastic sedimentary rocks:** are composed of fragments of weathered rocks, called clasts that have been transported, deposited, and cemented together. Such as sandstone, siltstone, and shale.



2. **Organic sedimentary rocks:** consist of the remains of plants or animals. Such as Coal and Diatoms.

3. **Chemical sedimentary rocks:** form by direct precipitation of minerals from solution. Such as rock salt (halite), gypsum.

4. **Bioclastic sedimentary rocks:** Most limestone is composed of broken shell fragments. The fragments are clastic, but they form from organic material. As a result, limestone formed in this way is called a bioclastic rock.

Sedimentary Structures:

1. **Stratification and Bedding**: Sedimentary rocks are bedded or layered because the agents of deposition carry different materials at different times.

Stratification and bedding

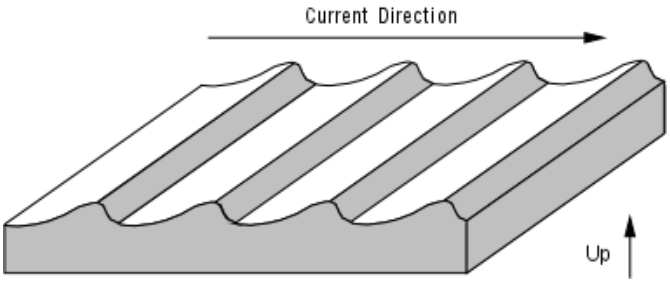
2. **Graded bedding:** Grain size changes from finer at the top to coarser at the bottom. The larger particles sediment deposit faster than finer particles in water. Or when a river slows down, again the larger particles settle faster.

Graded bedding

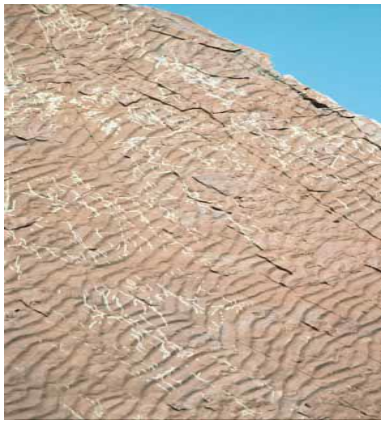
3. **Cross-bedding:** Wind or water may deposit material across sloping surfaces during sedimentation. This occurs because rivers cut and fill in response to different velocities, the cross beds are usually relatively thin and not well sorted. In wind-deposited sand the layers are thicker and very well sorted called **Dune**.

Cross-bedding

4. **Ripple marks:** These are like micro sand dunes and are produced by flow of water over fine sediment. It could be wave action or running water. They are usually asymmetric in cross section because of the flow of water in one direction. They are indicative of a relatively shallow environment of deposition.

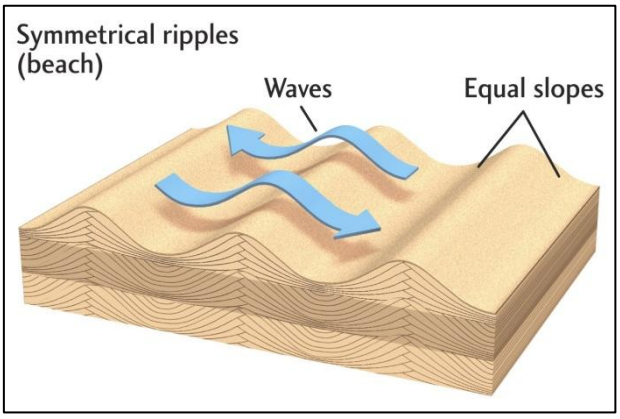


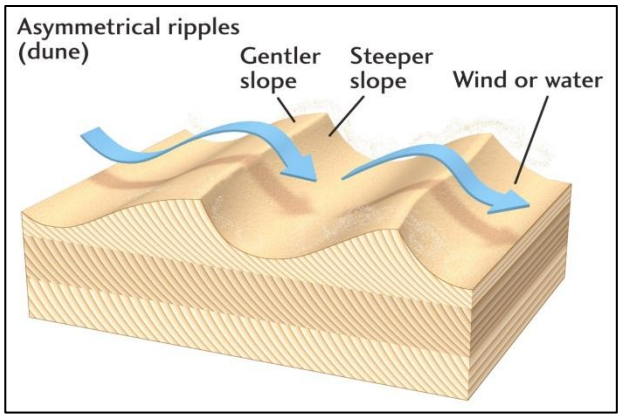
Ripple mark



Type of Ripple mark:

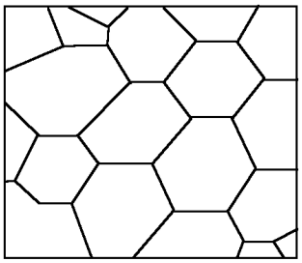
1. Symetrical ripples = back-and-front water motion (waves, tides).
2. Asymetrical ripples = water flowing in one direction (stream or river, long-shore current).





5. **Mud cracks:** When fine grained sediment dries out, it shrinks and forms polygonal mud cracks on the surface.

Mud cracks



Sedimentary Environments:

Each environment has its own energy regime and sediment delivery, transport and depositional conditions that are reflected in the sediment deposited.

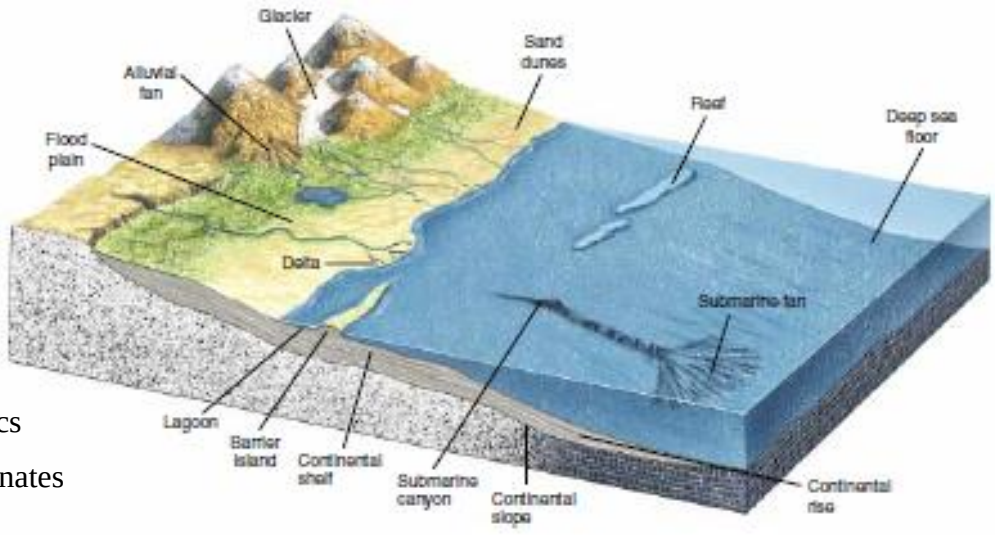
Sedimentary Environments can be divided into the following:

A. <u>Terrestrial (Non-marine) environments</u>

- Glacial
- Alluvial fans
- Sand Dunes
- Mountain Streams
- Lakes
- Rivers

B. <u>Marine environments</u>

- Deltas
- Coastal Beaches
- Shallow Marine Clastics
- Shallow Marine Carbonates
- Deep Marine



Sedimentary Facies:

It is deposits of sediment that have distinctive physical, chemical, or biological attributes.

- Coarse-grained deposits in a high-energy depositional environment are adjacent to finer grained sediments that are deposited in quieter water.
- Facies are typically recognized by grain size.

Transgressions and Regressions:

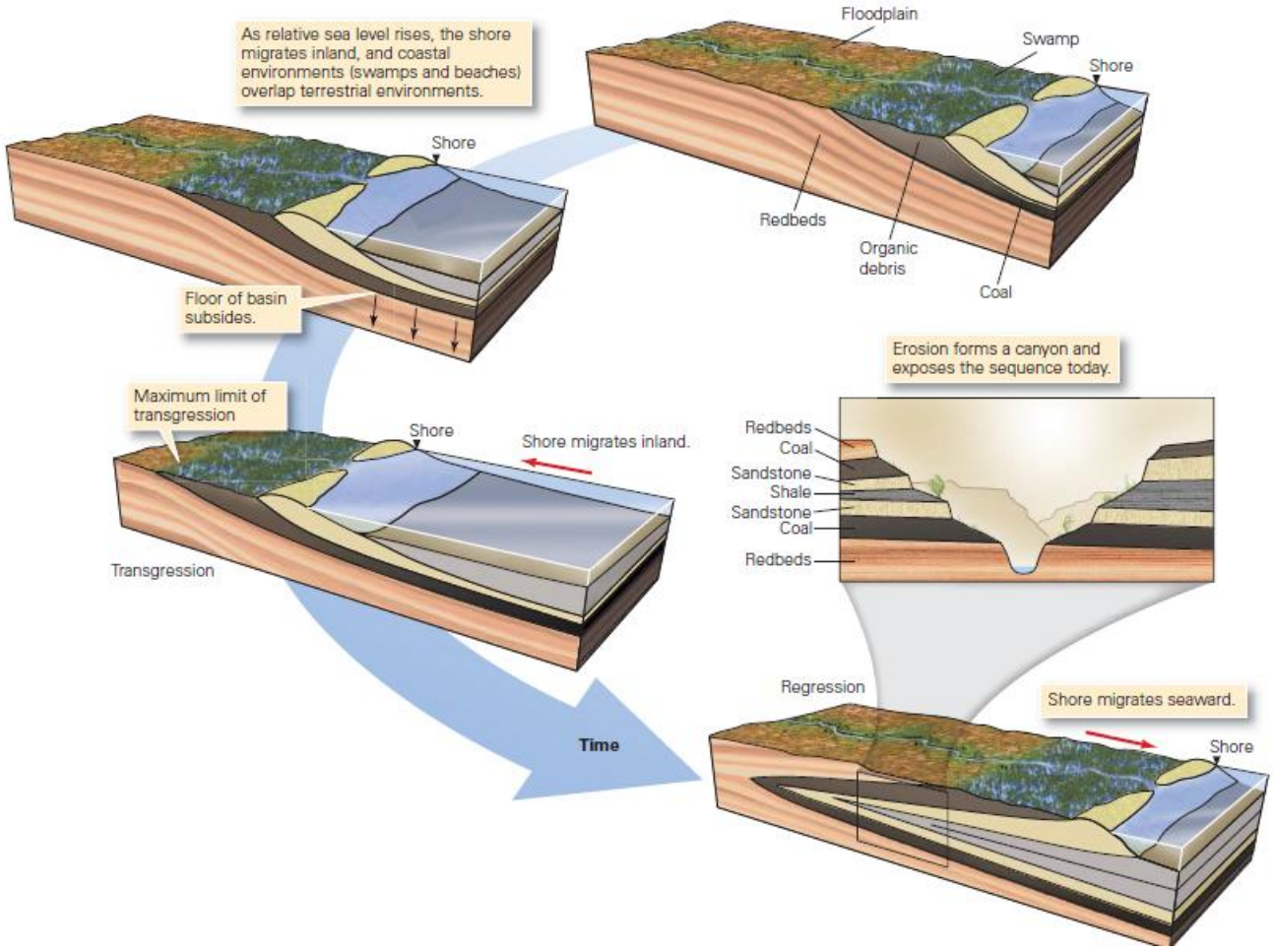
- Throughout geologic history sea level has risen and fallen by as much as a few hundred meters many times.
- These changes are the result of changes earth's climate or changes in the shape of the sea floor as a result of tectonics.

❑ **Transgressions**

• Rise in sea level relative to land, results in offshore facies being deposited over near-shore facies.

❑ **Regressions**

• Fall in sea level relative to land, results in near-shore facies being deposited over offshore facies.


As relative sea level rises, the shore migrates inland, and coastal environments (swamps and beaches) overlap terrestrial environments.
Shore
Floor of basin subsides.
Floodplain
Swamp
Shore
Redbeds
Organic debris
Coal
Maximum limit of transgression
Shore
Shore migrates inland.
Transgression
Erosion forms a canyon and exposes the sequence today.
Redbeds
Coal
Sandstone
Shale
Sandstone
Coal
Redbeds
Regression
Shore migrates seaward.
Shore
Time