Sedimentary Rocks and Features Earth and Space Science

SEDIMENTARY ROCK: Made from sediments consolidated at the earth's surface.

The sediments are deposited at the earth's surface by water, wind, glacial ice, or bio-chemical processes.

Typically the sediments are deposited in layers under COOL conditions [thereby distinguishing it from a layered volcanic rock].

**Types of Sedimentary Rocks**

Clastic – sedimentary rock made up of CLASTS (also termed grains or detritus) of preexisting rocks

 that have been physically transported to a place of deposition then “glued” together by

 COMPACTION AND CEMENTATION

* Examples: Conglomerate, Sandstone

🡪 Clast – an individual fragment of sediment produced by the physical disintegration of a

 larger rock mass

🡪 Compaction – the reduction in bulk volume or thickness of sediments due to increase weight

 and pressure from the continual deposition of material above

🡪 Cementation – the process by which sediments are converted into rock by the precipitation of a

 mineral “cement” between the grains of the sediments which “glues” the

 sediment together

Chemical - made of chemical precipitates or evaporite sediments, as the water in chemical

 solutions evaporates

* Examples: Limestone, Dolomite, Evaporites

Organic – made up of the remains of once living materials (dead plants and animals)

* Examples: Limestone, Coal

**Weathering & Erosion**

WEATHERING: The disintegration and decomposition of rocks and minerals by natural processes

 🡪 Changes that take place in a rock exposed at the Earth's surface.

* Mechanical - Big to little particles - NO CHEMICAL CHANGE!

🡪 A physical breakdown of the rocks to smaller pieces, but still the same composition

* Chemical - refers to:

 1) Dissolution (breaking up or separating) of minerals into more basic (simpler) compounds

 2) Formation of new minerals that are more stable at the lower temperature, lower

 pressure, and higher moisture at the Earth's surface (Example: feldspar --> clay).

EROSION: The gradual wearing away of rock or soil by physical breakdown, chemical solution, and

 transportation of material, as caused, e.g. by water, wind, or ice

 🡪 Typical erosional agents are: wind, rain, ice, freezing and thawing temperatures, moving

 water (such as rivers, wave action, tidal motion), acid rain, glaciers, physical contact

**Transportation & Deposition**

**For Clastic rocks**: Clasts (sediments) are physically transported by wind, water, glaciers, and/or gravity.

* Clasts are deposited when the transportation energy is insufficient to move the particle. As transportation energy decreases, the larger (heavier) particles are deposited first.
* HIGH ENERGY environments can transport large and small particles
* LOW ENERGY environments can transport only small particles

Examples of high and low energy environments?

|  |  |
| --- | --- |
| **Low Energy Environment**  | **High Energy Environment**  |
| Lagoon  | Storm-Dominated Beach  |
| Deep Lake  | Steep Mountainside (Landslide)  |
| Deep Ocean  | Tornado  |
|  | Tsunami  |

NOTE: The longer the transportation distance, the more exposure the sediment has to chemical and physical weathering, and the rounder and smaller the sediments generally become.

**For Chemical rocks**: Chemical sediments are generated by the precipitation of minerals out of solution by biological activity, chemical change, or evaporation. These minerals (chemical sediments) are precipitated when the dissolved ion concentration becomes too large to remain in solution.

***Where do these dissolved ions come from?***

This is an important question since the dissolved ions are the "building blocks" for the chemical sediments. It is the chemical weathering of sediments (dissolution of minerals) that releases these ions into solution. Once in solution, the ions can travel in groundwater, rivers, etc. to their final destination (such as an ocean, lake, cave, etc.) where they are precipitated as minerals.

**For Organic Rocks**: Remains of plants and animals may fall to the ground or into water, and are then washed downstream, may come to rest at the bottom of a swamp, pond, lake, or ocean, and are then covered over with other sediments. Over time the compaction of the organic materials, along with the decay of the organic materials changes the dead stuff into rock

**Texture: (For Clastic Rocks Only)**

**1) Particle Size**:

* Clay (Very Fine Grained): < 1/256 mm
* Silt (Fine Grained) : 1/256 to 1/16 mm
* Sand (Medium Grained) : 1/16 to 2 mm
* Pebbles (Coarse Grained) : > 2 mm

Particle size indicates the energy of the transporting medium. The larger the size of grains in a clastic rock, the more energy it took to move that particle to the place of deposition!

**2) Angularity**: Degree to which the individual sedimentary particles are rounded.

* WELL ROUNDED - all corners of a grain are rounded off
* ANGULAR - all corners of a grain are still sharp (pointed)

The more the corners of an individual grain in a clastic rock are rounded, the longer the distance the grain has been transported.

**3) Sorting**: Degree to which the sedimentary particles are the same size.

* POORLY SORTED - large and small grains jumbled together
* WELL SORTED - all grains are the same size!

Poor sorting suggests that the particles have not been transported very far.

**[Clastic Rocks: Let's pull all of this together!](http://www.geo.utexas.edu/courses/303/303_lab/Sedimentary%20Lab303.html%22%20%5Cl%20%22pulltog)**

What would be some general trends seen if you were to look at the sediments being weathered, eroded, and transported from a granite mountain to the plains to a deep lake or ocean?

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| --- |
| **General trends: Distance from sediment source vs. texture and mineralogy**  |
|  | **At source**  | **Near source** | **Intermediate from source**  | **Far from source**  | **Farthest from source**  |
| **Largest grain size seen** | boulder-sized  | pebble to sand  | sand  | silt  | clay-sized  |
| **Angularity** | angular  | sub-rounded  | rounded  | well rounded  |  |
| **Sorting** | poor  | poor to moderate  | moderate to well  | well  | well  |
|  |  |  |  |  |  |
| **Typical clastic rock**  | breccia  | conglomerate, arkose  | quartz sandstone  | siltstone  | shale  |

**Sedimentary Structures and Fossils--things found in sedimentary rocks**

1. Stratification - horizontal layering at time of deposition
2. Ripple Marks - undulatory structures due to wind/water current
3. Cross Bedding - internal angular layering within a horizontal bed (due to ripple mark remnants)
4. Mud Cracks (Desiccation Cracks) - when mud (basically clay) dries, it shrinks and pulls apart from itself--forming polygonal columns.

**Fossils** - evidence of past life (either a remnant of the organism itself or its activity); can indicate

 where the sediments were deposited

 🡪 Fossils may include (but are not limited to):

 - Bones and / or bone fragments

 - Shells and / or shell impressions

 - Foot / paw prints or tracks of any kind

 - Waste materials (droppings)

 - Preserved materials (such as mosquitos in fossilized amber)

 - Nesting remains