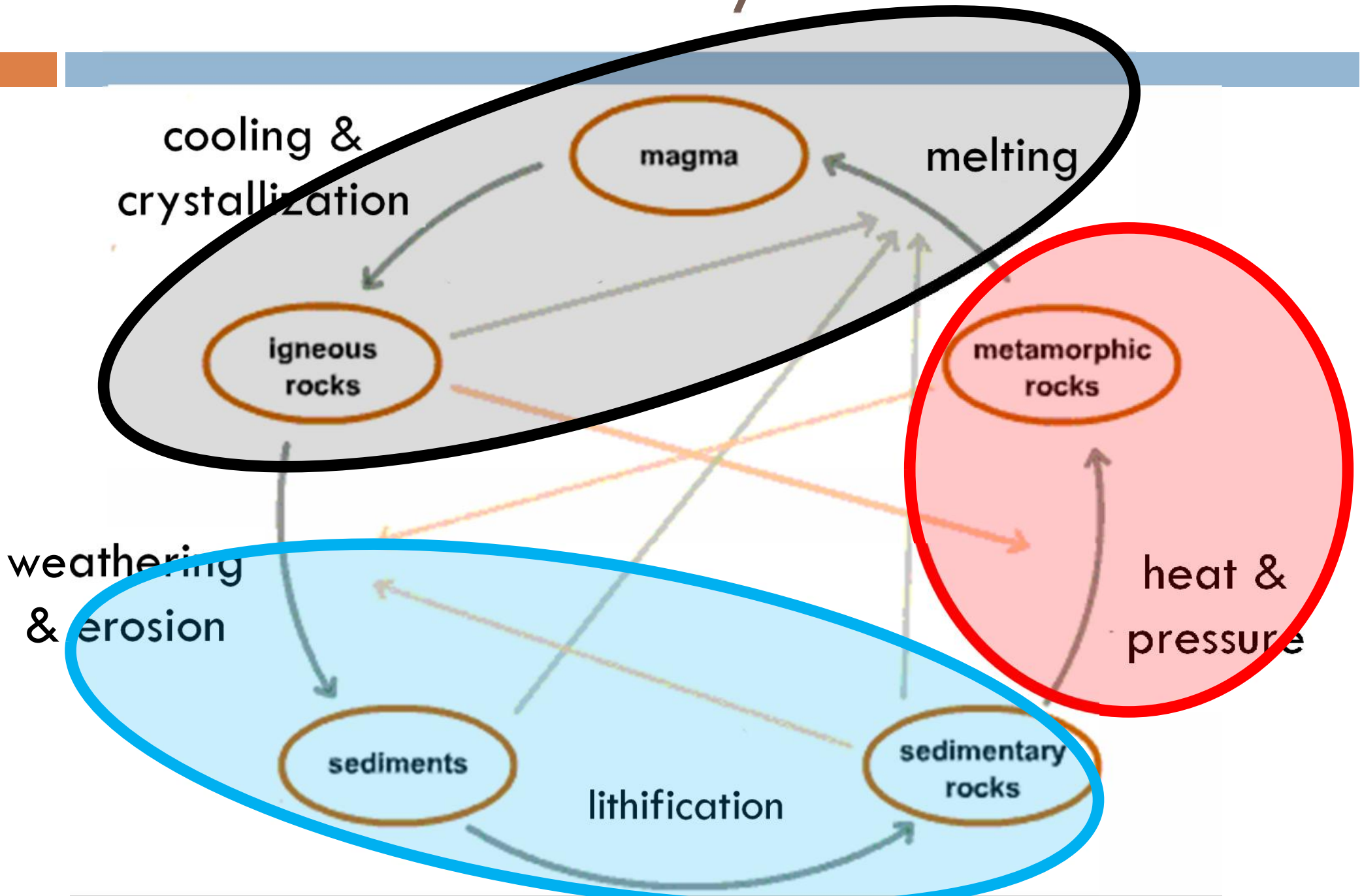
INTRODUCTION TO SEDIMENTARY ROCKS

Rock cycle


cooling &
crystallization
magma
melting
igneous
rocks
metamorphic
rocks
heat &
pressure
weathering
& erosion
sediments
lithification
sedimentary
rocks

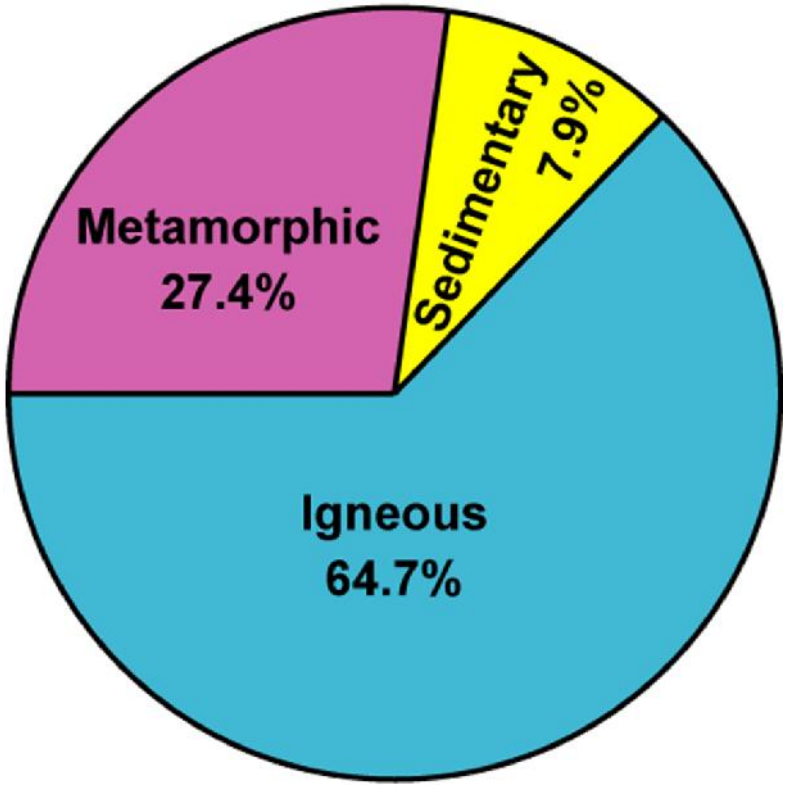
Things to remember…

- Sedimentary processes
- Sedimentary texture
- Classification of sedimentary rocks
- Sedimentary structures
- Sedimentary environments

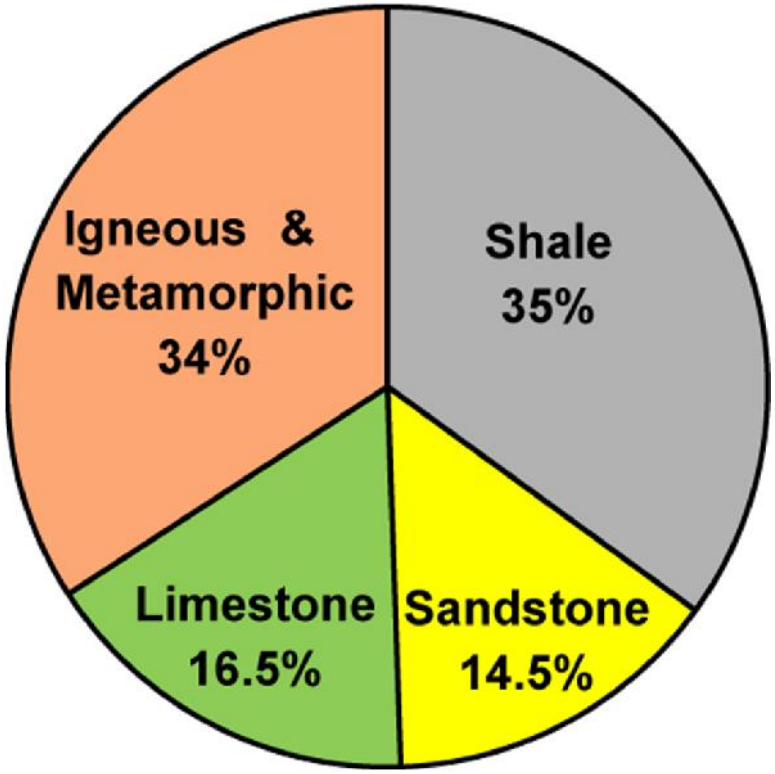
Introduction

- Humans interact with the Earth largely at or near its surface.

Relative abundance of rocks in the earth's crust



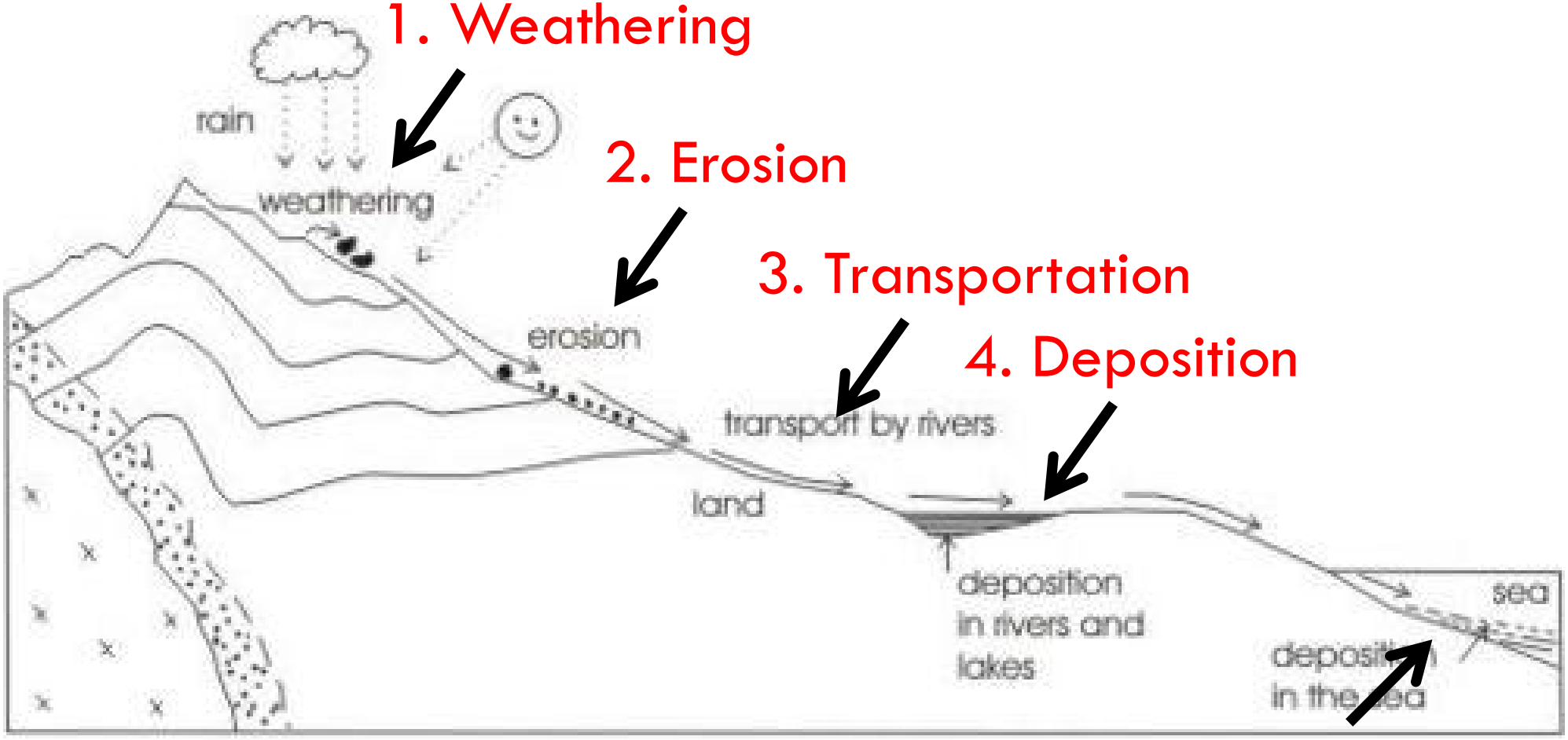
Relative abundance of rocks at the earth's surface



Types of sedimentary rocks

- Clastic
  - particles derived from the weathering and erosion of precursor rocks and consist primarily of fragmental material
  - classified by grain size and composition
- Biogenic
  - precipitated by a variety of organic and inorganic processes
- Chemical
  - evaporation of water at the Earth's surface

Sedimentary Processes



Sedimentary Processes

- ***Weathering*** **–** transforming solid rock into smaller fragments or dissolved ions by physical and chemical weathering

- ***Erosion*** – moving the weathered products from their original location. This can take place by gravity (mass wasting events like landslides or rock falls), by running water, by wind, or by moving ice.

Sedimentary Processes

- ***Transportation*** – Sediment can be transported by sliding down slopes, being picked up by the wind, or by being carried by running water in streams, rivers, or ocean currents.

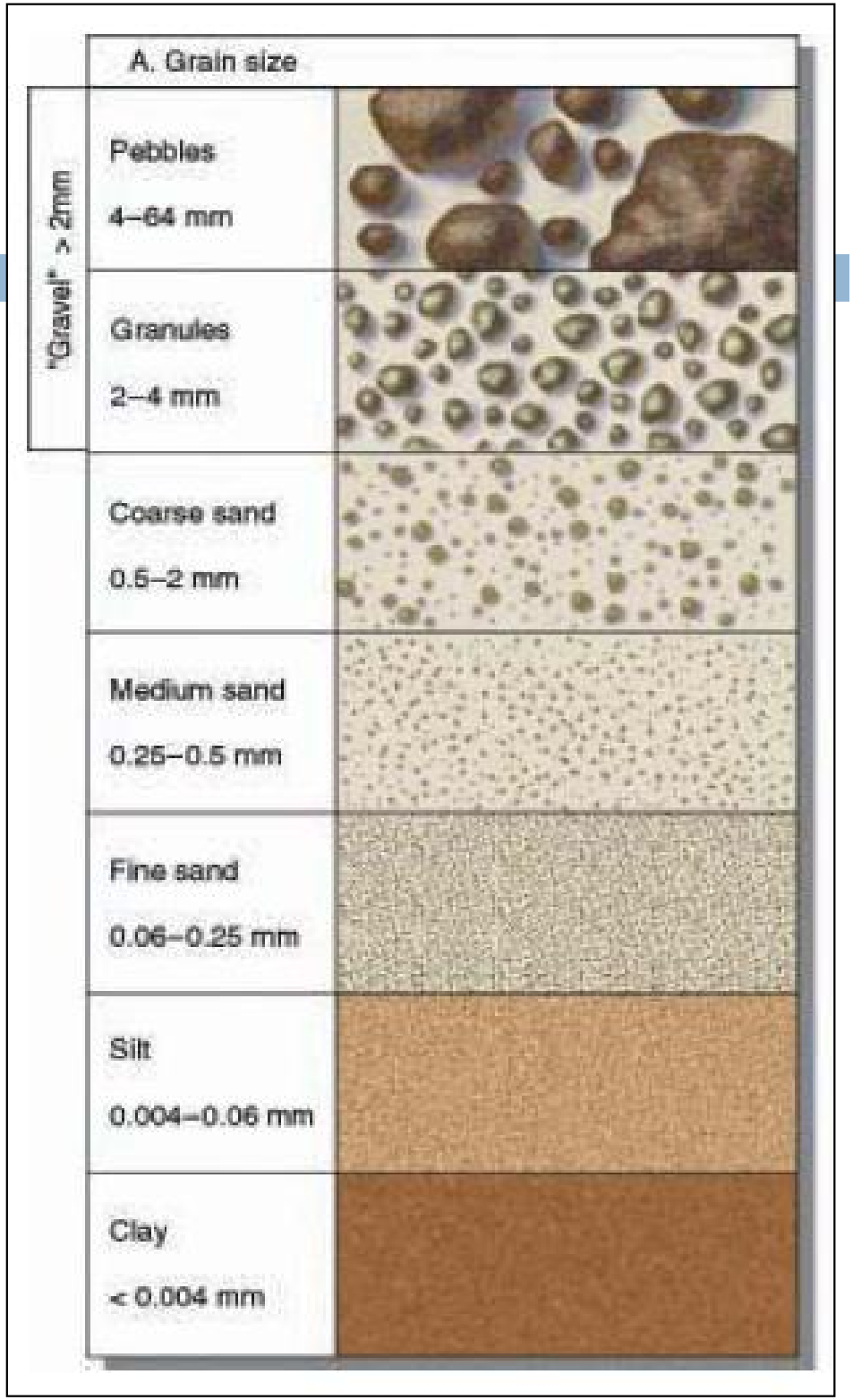
- ***Deposition*** **–** Sediment is deposited when the energy of the transporting medium becomes too low to continue the transport process.

Sedimentary Processes – *Lithification (Diagenesis)*

- Lithification is the process that turns sediment into rock.
- Compaction occurs as the weight of the overlying material increases. Compaction forces the grains closer together, reducing pore space and eliminating some of the contained water.
- Some of this water may carry mineral components in solution, and these constituents may later precipitate as new minerals in the pore spaces. This causes cementation, which will then start to bind the individual sedimentary rocks

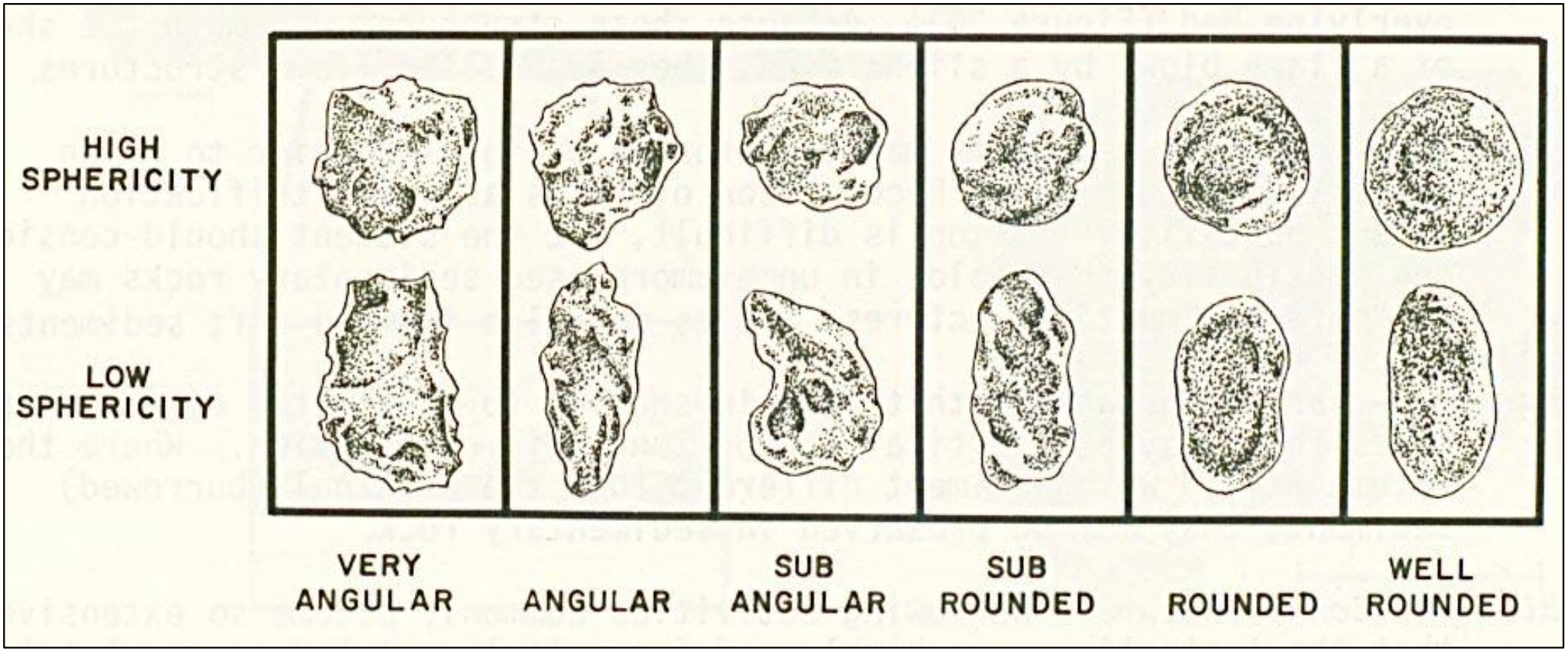
Grain size

Name of particle	Size range	Consolidated rock
Boulder	> 256 mm	Conglomerate / Breccia
Cobble	64 – 256 mm	
Pebble	2 – 64 mm	
Sand	1/16 – 2 mm	Sandstone
Silt	1/256 – 1/16 mm	Siltstone
Clay	< 1/256 mm	Claystone, mudstone, shale



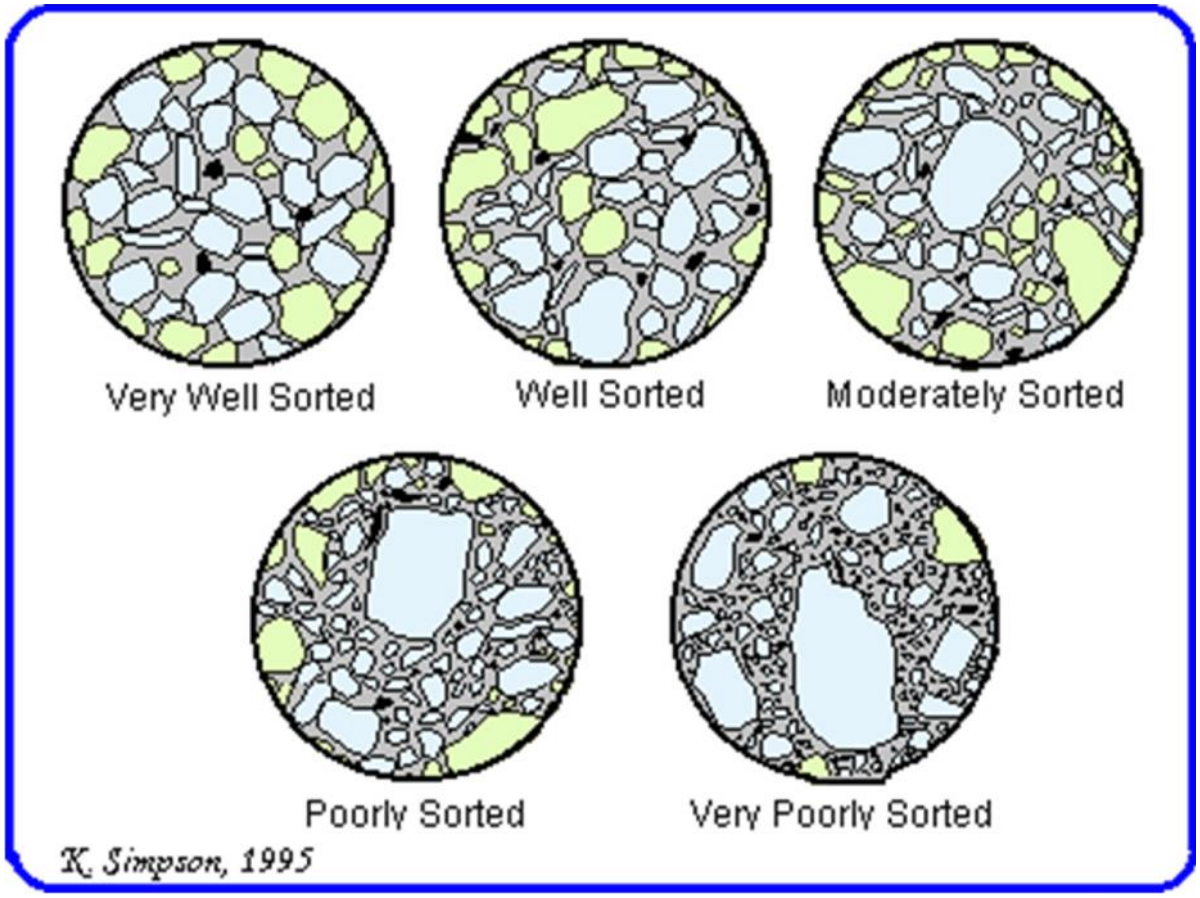
Grain shape - ***Rounding***

- During the transportation process, grains may be reduced in size due to abrasion. Rounding of grains gives us clues to the amount of time a sediment has been in the transportation cycle.



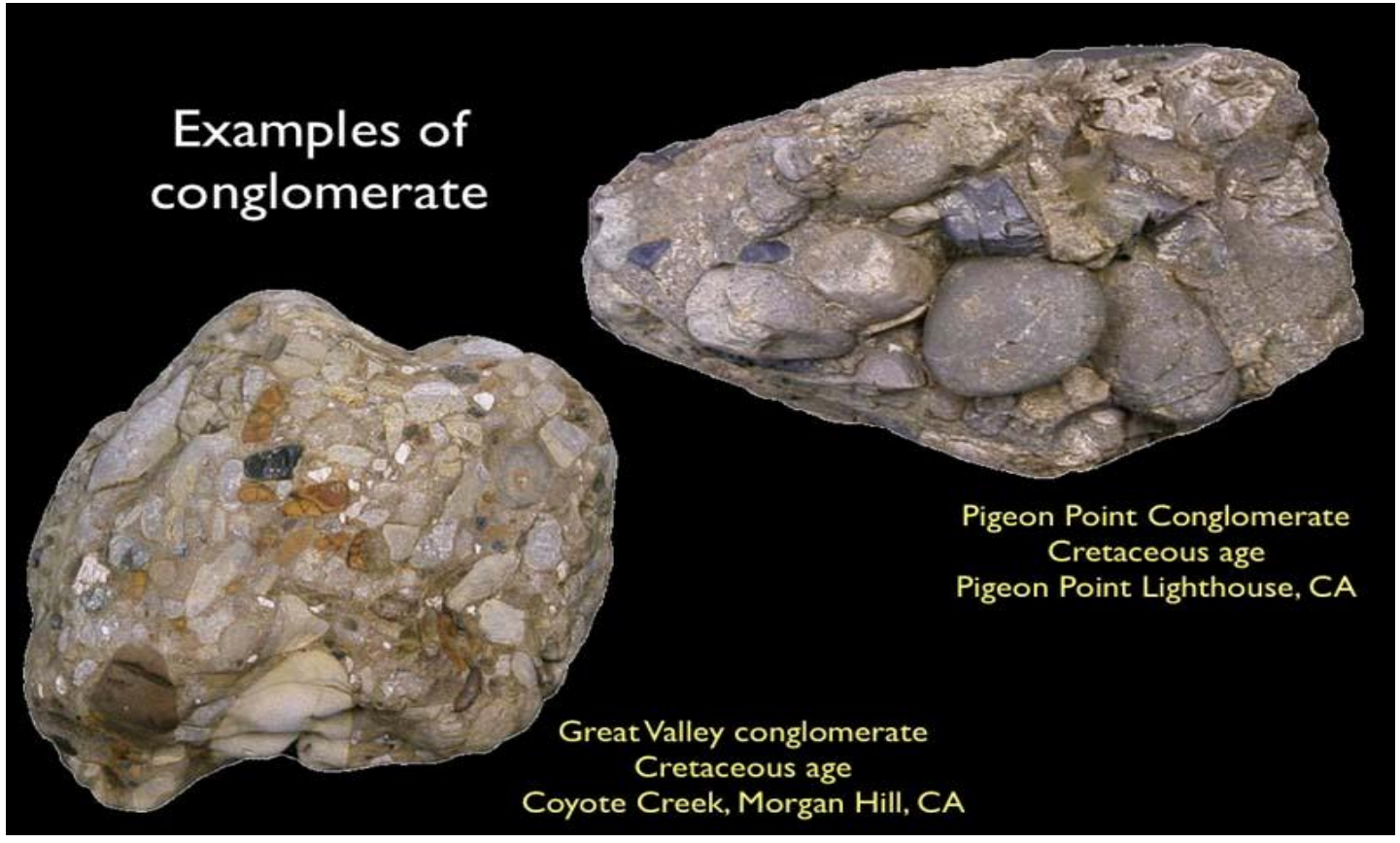
Sorting

- The degree of uniformity of grain size.
- High energy currents can carry larger fragments. As the energy decreases, heavier particles are deposited and lighter fragments continue to be transported.
- Example: Beach deposit



Types of Clastic sedimentary rocks - Conglomerates

- Sedimentary rocks that contain an abundance of coarse grained <u>well rounded</u> clasts (pebbles, cobbles, or boulders).



Types of Clastic sedimentary rocks - Breccias

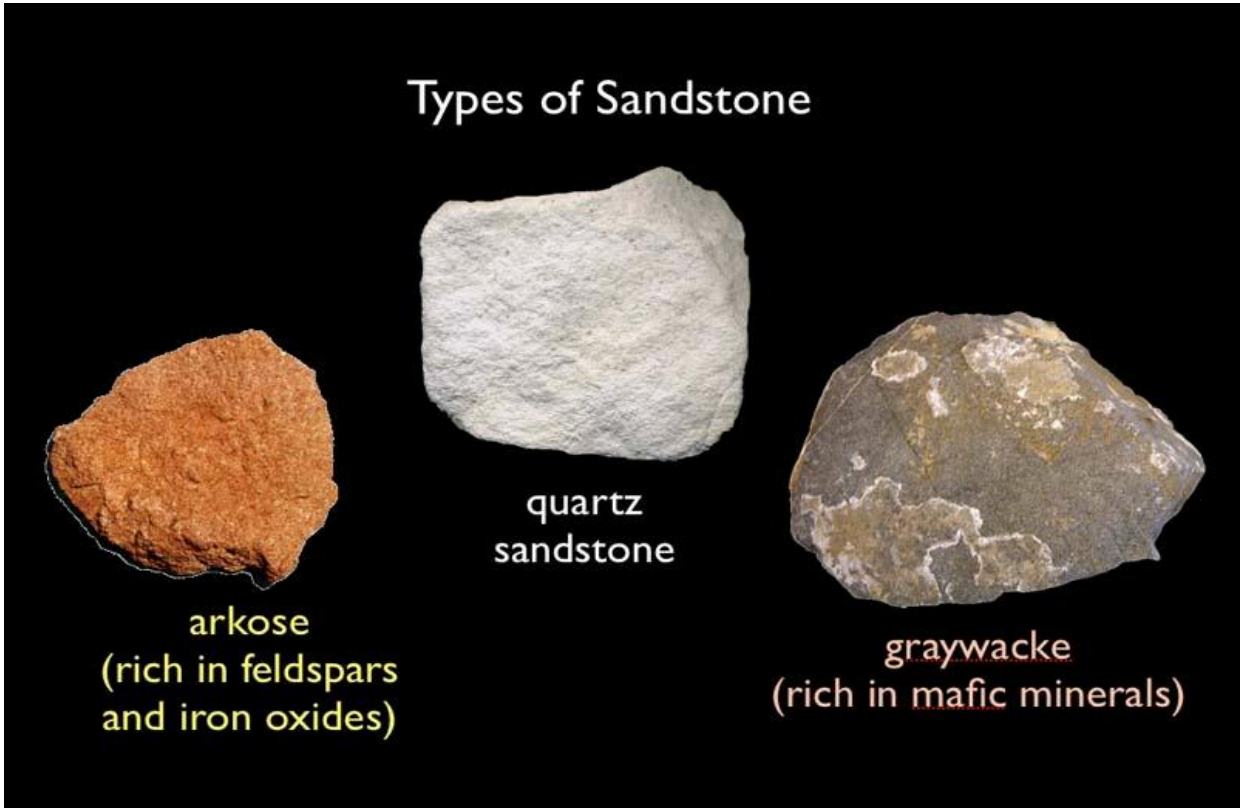
- Sedimentary rocks that contain an abundance of coarse grained angular clasts, indicating the clasts spent little time in the transportation cycle

Types of Clastic sedimentary rocks - Sandstone

- A Sandstone is made of sand-sized particles .
- Texture and composition permit historic interpretation of the transport and depositional cycle and sometimes allows determination of the source.

Sandstone

- A Quartz arenite – is nearly 100% quartz grains.
- An Arkose contains abundant feldspar
- Wacke is a sandstone that contains more than 15% mud



Types of Clastic sedimentary rocks - Mudrock

- Mudrocks are made of fine grained clasts (silt and clay sized) .
- A siltstone is one variety that consists of silt-sized fragments.
- A shale is composed of clay sized particles and is a rock that tends to break into thin flat fragments. Organic-rich shales are the source of petroleum.
- A mudstone is similar to a shale, but does not break into thin flat fragments.

Types of Clastic sedimentary rocks - Shale

Biochemical and Organic Sediments and Sedimentary Rocks

- Underlying Process:
  - Biochemical and Organic sediments and sedimentary rocks are those derived from living organisms.
  - When the organism dies, the remains can accumulate to become sediment or sedimentary rock.
  - These rocks includes a number of fossils

Biogenic sedimentary rock - ***Limestone***

- ***Calcite (*$CaCO_3$*)*** is precipitated by organisms usually to form a shell or other skeletal structure.
- Accumulation of these skeletal remains results in a limestone.

Biogenic sedimentary rock - *Chert*

- Tiny silica secreting planktonic organism like Radiolaria and Diatoms can accumulate on the sea floor and recrystallize during lithification to form biochemical chert.

Biogenic sedimentary rock - ***Diatomite***

- When diatoms accumulate and do not undergo recrystallization, they form a white rock called diatomite

Biogenic sedimentary rock - ***Coal***

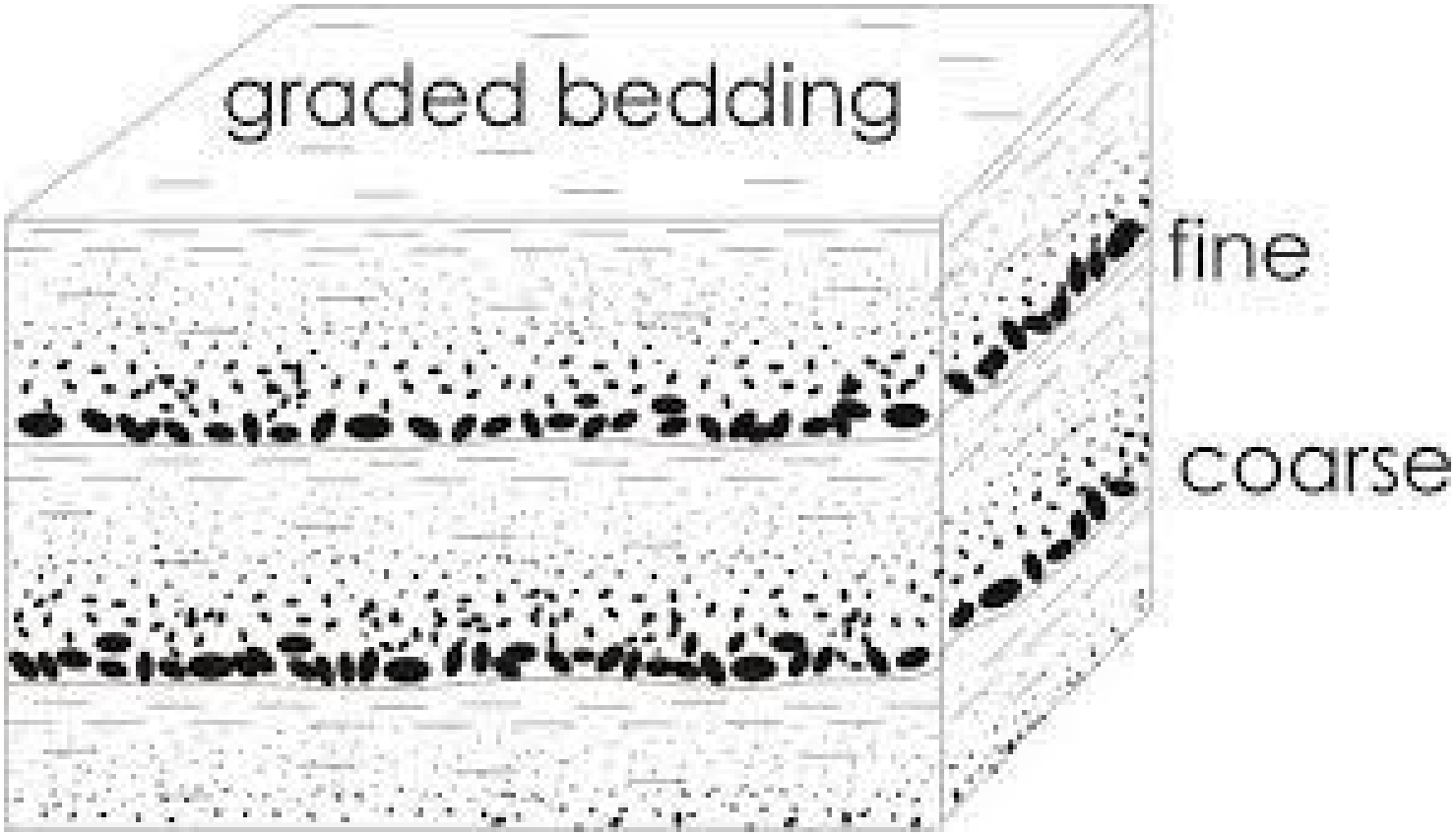
- Coal is an organic rock made from organic carbon that is the remains of fossil plant matter.
- It accumulates in lush tropical wetland settings and requires deposition in absence of Oxygen.

Chemical Sediments and Sedimentary Rocks

- Dissolved ions released into water by the weathering process are carried in streams or groundwater.
- Eventually these dissolved ions end in up in the ocean, explaining why sea water is salty.
- When water evaporates, precipitation happens to form minerals that can accumulate to become chemical sediments and chemical sedimentary rocks.
- Most common rock is Evaporites.
- Formed by evaporation of sea water or lake water. Produces halite (salt) and gypsum deposits by chemical precipitation.

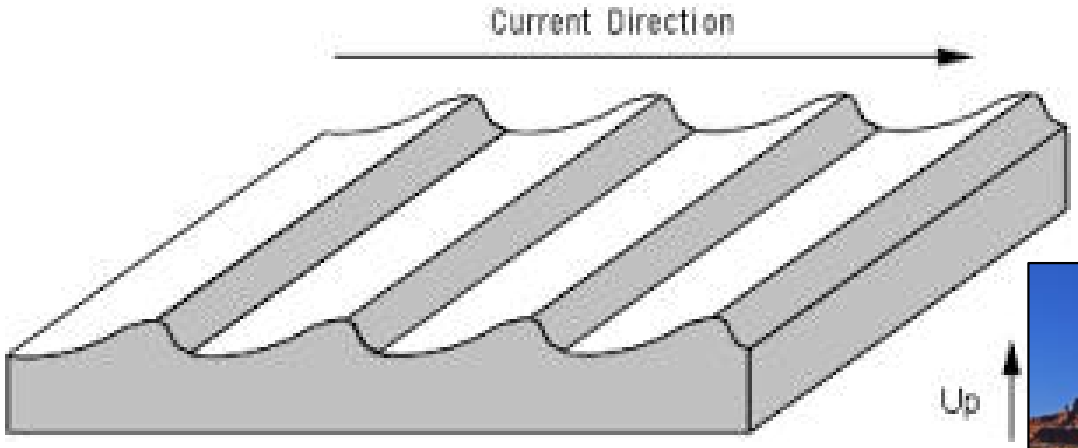
Sedimentary structures – *Graded Bedding*

- As current velocity decreases, coarsest material settles first, medium next, then fine.



Sedimentary structures - *Ripple Marks*

- Water flowing over loose sediment creates bedforms by moving sediment with the flow.



Sedimentary structures – *Mudcracks*

- Drying out of wet sediment at the surface of the Earth. The cracks form due to shrinkage of the sediment as it dries.
- When present in rock, they indicate that the surface was exposed at the earth's surface and then rapidly buried.

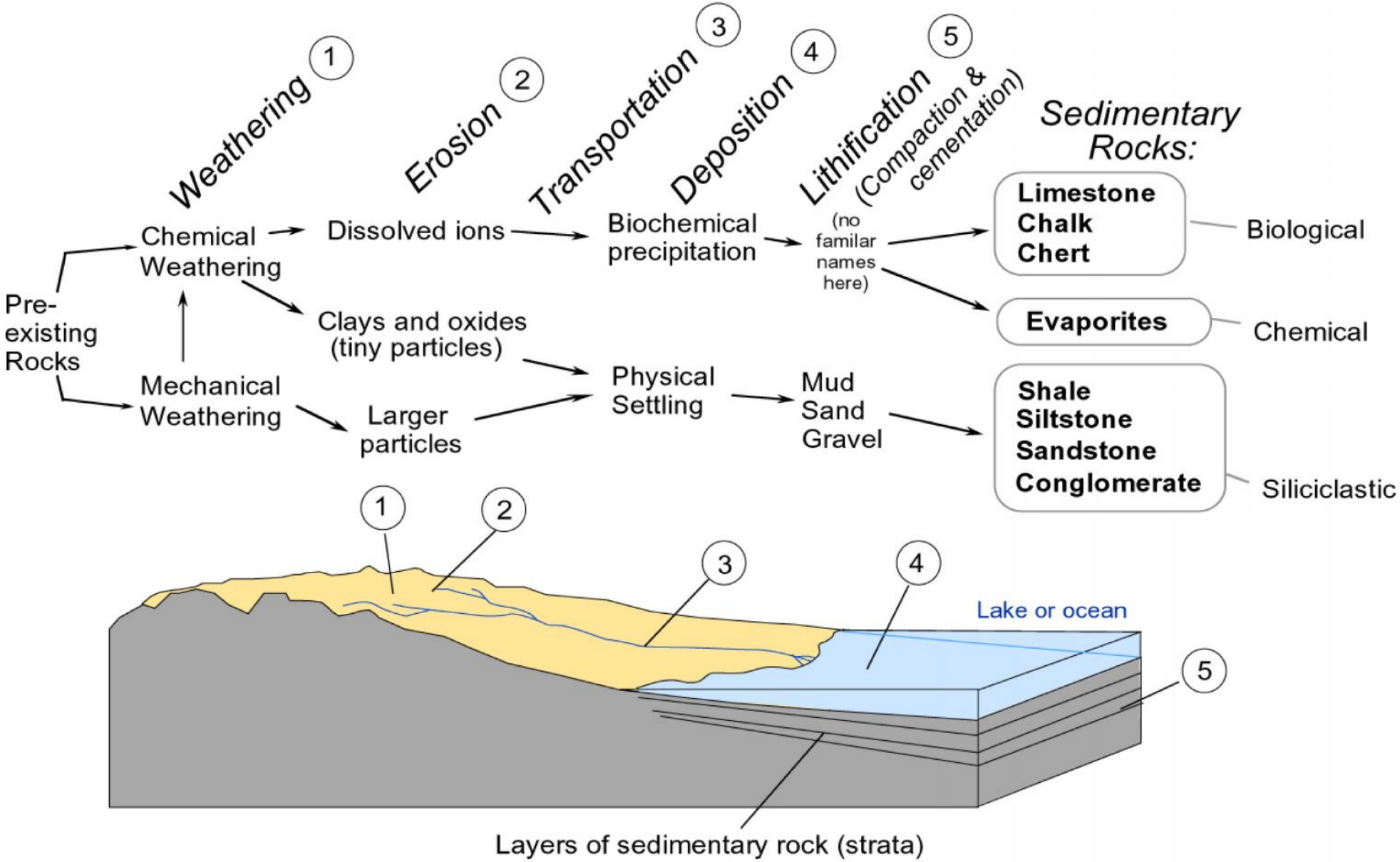
Sedimentary environments

- Different environment has unique sediments and sedimentary rocks.
- These differences arise from the difference of energy regime and sediment delivery, transport and depositional conditions
- Therefore, looking at sedimentary rocks can help us to interpret the environment of the past

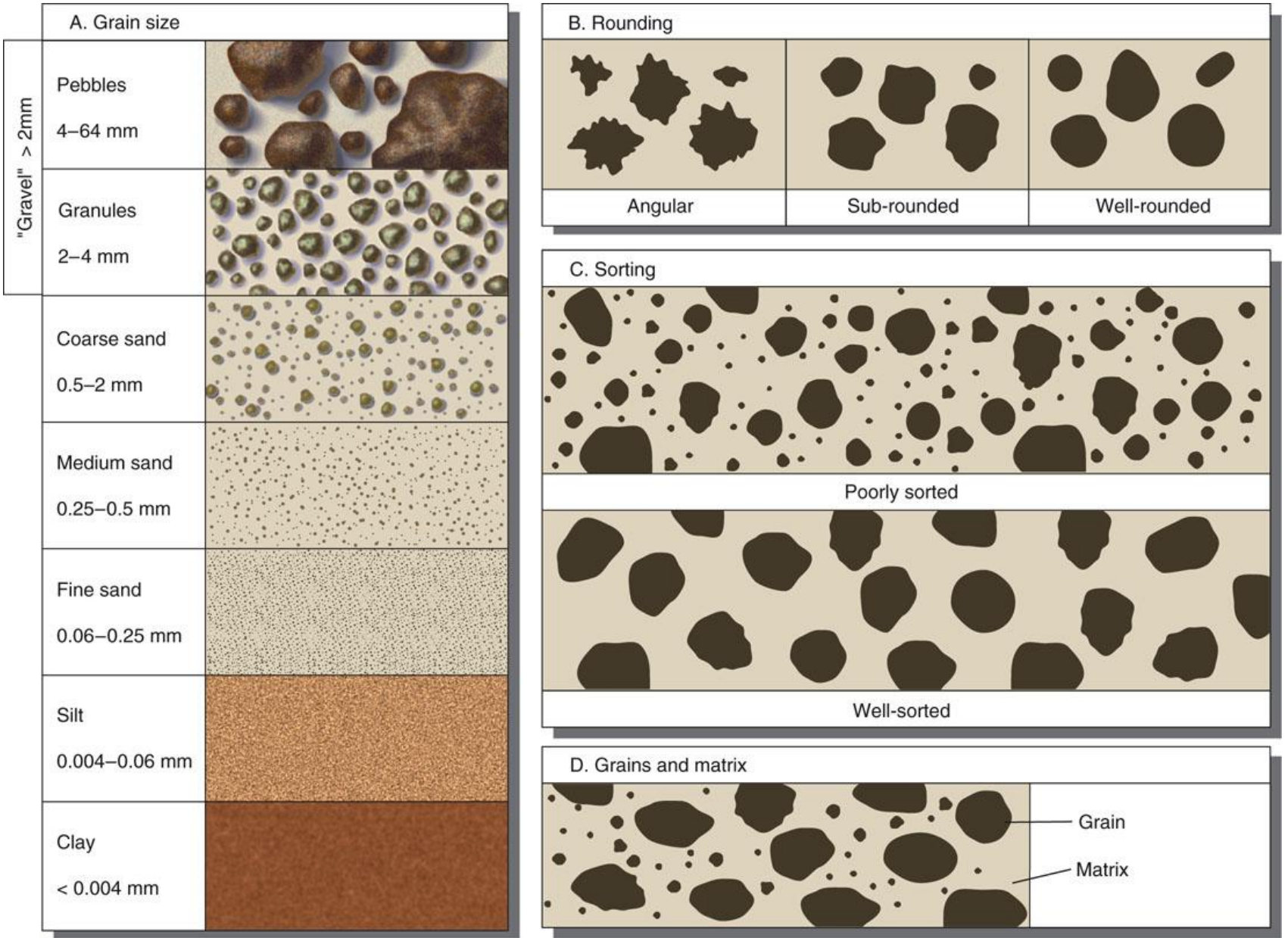
Sedimentary environments & rock types

Sedimentary Environments	
Glacial deposits	
Eolian deposits	
Lakes	
Rivers	
Swamp	
Beach	
Deep marine	

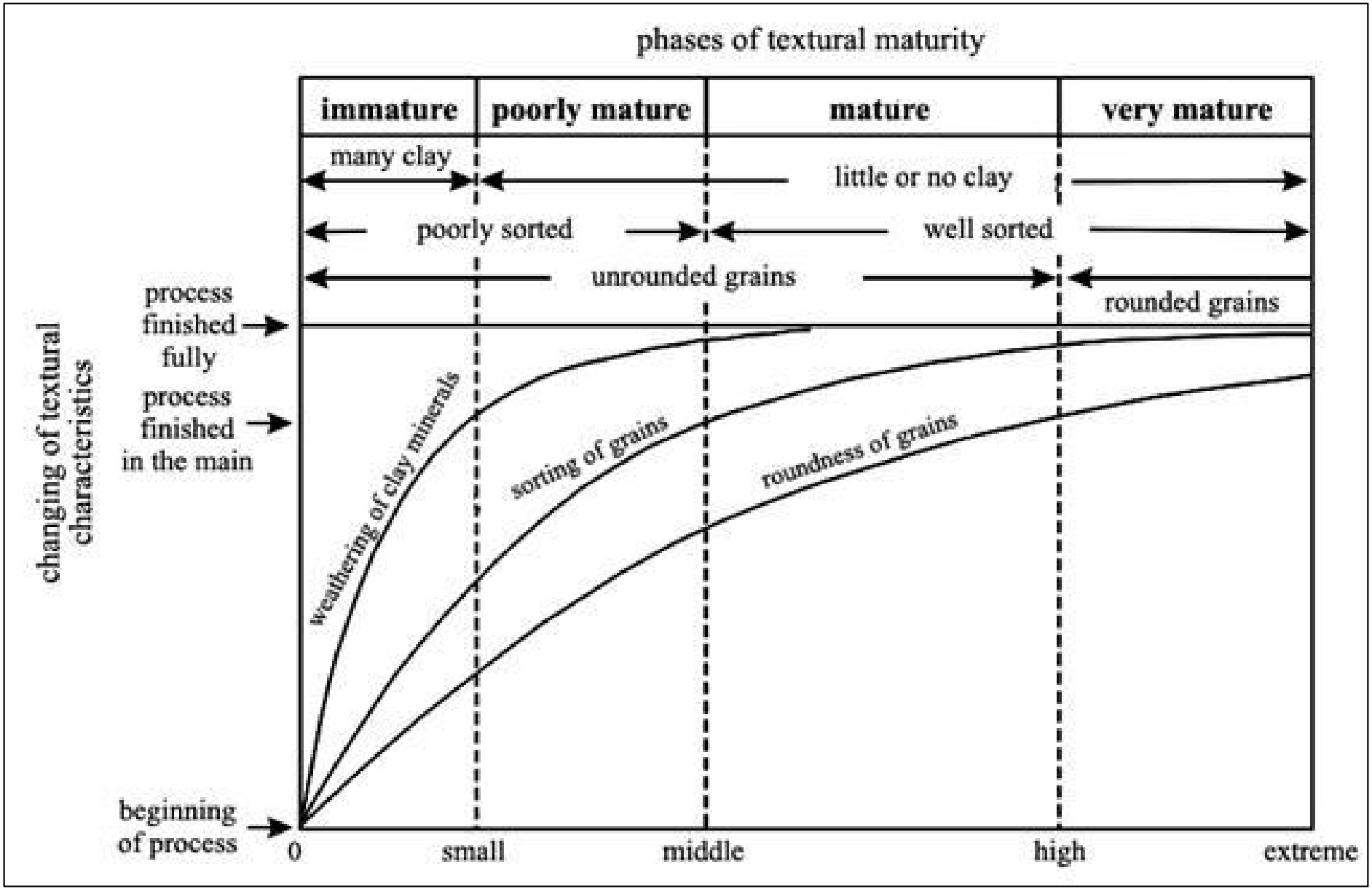
Sedimentary Processes & Rocks



Summary of sedimentary texture



Sediment Maturity



Sedimentary structures - *Cross Bedding*

- Sets of beds that are inclined relative to one another. The beds are inclined in the direction that the wind or water was moving at the time of deposition. Boundaries between sets of cross beds usually represent an erosional surface. Very common in beach deposits, sand dunes, and river deposited sediment.