Summary

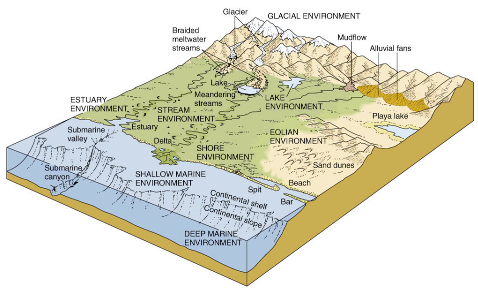
- Sediment is transported by streams, glaciers, wind, slope processes, and ocean currents.
- Stratification results from the arrangement of sedimentary particles in layers. Each bed or group of beds in a succession of strata is distinguished by its distinctive thickness or character.
- Clastic sediment consists of fragmental rock debris resulting from weathering, together with the organic remains. Chemical sediment forms where substances carried in solution are precipitated.
- Particles of clastic sediment become rounded and sorted during transport by water and air; particles transported by glaciers are not sorted.
- Various arrangements of the particles in strata are seen in parallel strata and cross strata, graded bedding, and non-sorted layers.
- An extensive body of strata may possess several facies, each determined by a different depositional environment. The boundaries between facies may be abrupt or gradational.

- Most sedimentary strata are built of continental detritus that is transported to the submerged continental margins. Some is trapped in basins on land where it is deposited by non-marine processes. A small percentage reaches the deep sea.
- Depositional environments of non-marine and shallow-marine sediments can be inferred from such properties as texture, degree of sorting and rounding, character of stratification, and types of contained fossils.
- Coarse land-derived sediment reaching the continental margins is deposited close to shore. Finer sediment is deposited on the continental shelves and slopes and in the deep sea. Extensive areas of the shelves are covered by relict sediments deposited at times of lowered sea level.
- Carbonate shelves are found in low latitudes, where warm waters promote growth of carbonate-secreting organisms.
- Marine evaporite deposits accumulate in restricted marine basins, where evaporation is high and continual inflow provides a supply of saline water.

- By depositing turbidites, turbidity currents have built thick deposits of sediment at the base of the continental slope.
- The chief kinds of sediment on the deep seafloor are brownish or reddish clay, calcareous ooze, and siliceous ooze. Their distribution is largely related to surface water temperature, water depth, and surface productivity.
- During diagenesis, compaction, cementation, recrystallization, and chemical alteration act to transform sediment into sedimentary rock.
- Clastic sedimentary rocks, like clastic sediments, are classified mainly on the basis of predominant particle size. Conglomerate, sandstone, siltstone, and mudstone or shale are the rock equivalents of gravel, sand, silt, and clay.
- Limestone is an important and widespread biogenic rock that forms primarily in warm marine environments and stores carbon dioxide in the Earth’s crust.
- Sediment is constantly being recycled, moving from continent to ocean and back to continent
- Exceptionally thick strata are associated with specific plate tectonic settings- contrast “passive margins” from “active margins”.
- Extensive Limestone strata were deposited during times of high carbon-dioxide in the atmosphere

Sediments:

- Cover most of Earth's surface
- Deposited by:
  - Water (most)
  - Air
  - Glacier Ice
  - Mudflows
  - Landslides

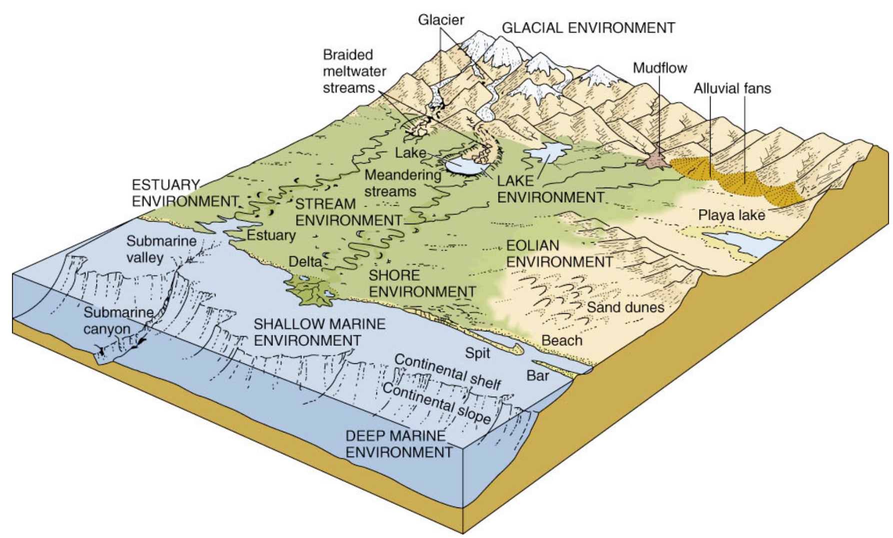


Importance of Sedimentary Rocks:

- Information about past environments
- Origins
  - where did the sediments come from?
- Processes
  - How transported?
  - How deposited?
  - How lithofied?
- Connection to Plate Tectonics

To Understand Need

- Vocabulary
- Classification Schemes



- Clastic
- Chemical

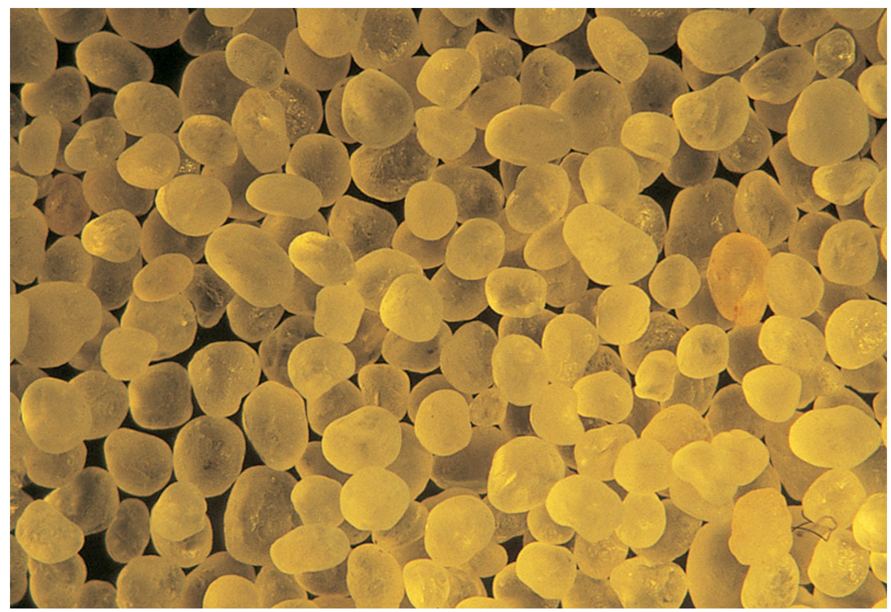
Clastic Rocks
Greek root: Klastos==broken

- Clay
- Silt
- Sand
- Gravel (pebble, cobble, boulder)

Transported, Shaped, Sorted by water and wind

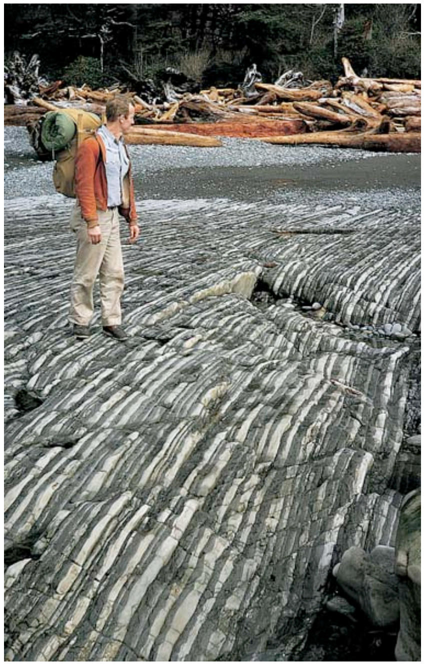
- Fragments can identify source
- Process determined by:
  - Shape,
  - size,
  - sorting

- **Sorting: variability in the size of its particles.**
  - **Poorly sorted (wide range of particle size),**
  - **Well sorted (range is small).**
- **Changes of grain size**
  - **fluctuations in the velocity of the transporting agent.**
  - **Higher speed and energy: larger or heavier particles are transported.**



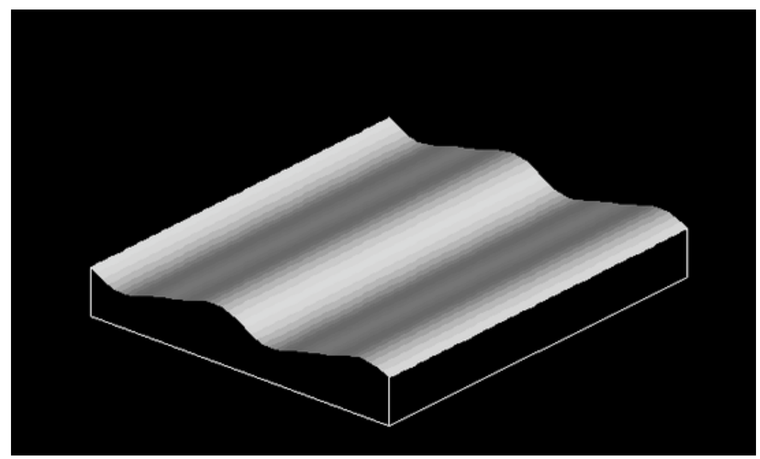
Sedimentary Rock Features

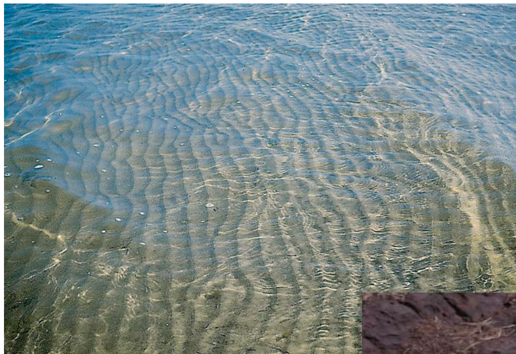
- Stratification
  - Often parallel and horizontal
  - Sometimes alternating (annual cycles **- varves**)
  - **Cross-bedding** (fluvial or eolian)
  - ***Graded bedding,*** particles sorted according to size, grading upward from coarser to finer.



Differing Environments

- Beach
- Sand dune
- River
- Lake
- Swamp





Chemical Sediments

- Formed by precipitation of minerals from solution in water.
  - Through biochemical reactions: activity of plants and animals in the water.
  - Inorganic reactions in the water.
    - When water from a hot spring cools, it may precipitate opal (a hydrated silicate) or calcite (calcium carbonate).

Evaporation of sea water or lake water forms salts.

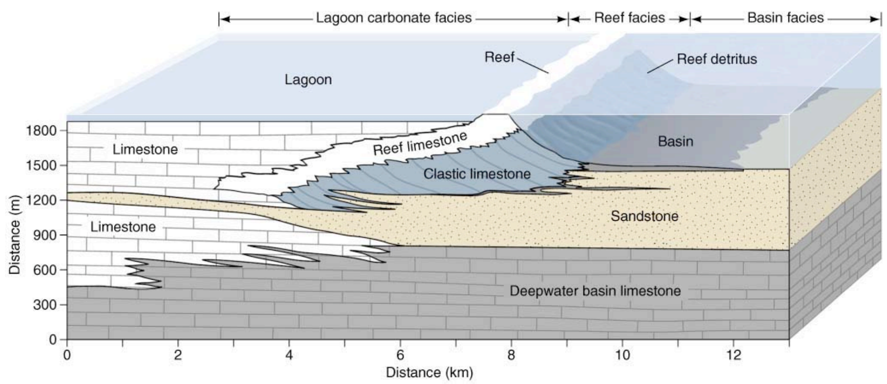
- **Lake waters precipitate sodium carbonate (Na_2CO_3), sodium sulfate Na_2SO_4), borax ($Na_2B_4O_7 \cdot 10H_2O$),and trona ($Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$).**
- **seawater precipitates halite (rock salt: NaCl) and gypsum ($CaSO_4 \cdot 2H_2O$).**

Economic Deposits

- **Chemicals for production of**
  - **Paper.**
  - **Soap.**
  - **Detergents.**
  - **Antiseptics.**
  - **Tanning and dyeing.**
- **Gypsum (plaster and construction material)**
- **Table salt**

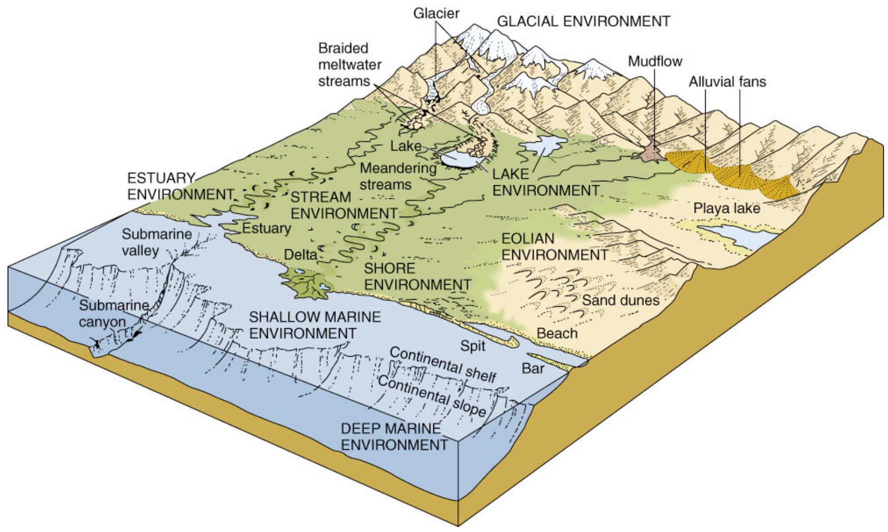
Biogenic Sediments

- Contain fossils.
  - If broken and scattered it is ***bioclastic*** sediment.
- ***deep-sea ooze*** :
  - When floating microscopic marine organisms die, their remains settle and accumulate on the seafloor to form a muddy sediment.
  - ***Siliceous ooze*** skeletal material made mainly of silica *from* tiny floating protozoa (radiolarians) and algae (diatoms).
  - ***calcareous ooze*** fine-grained, deep-sea deposit of skeletal material containing more than 30% calcium carbonate.



Sedimentary Environments And Facies Changes

- Vertical changes in strata: passage of time.
- Horizontal change within the same stratum.
  - lateral change from one depositional environment to another is a change of ***facie***s.
- Each environment has distinctive physical, chemical, and biological characteristics.

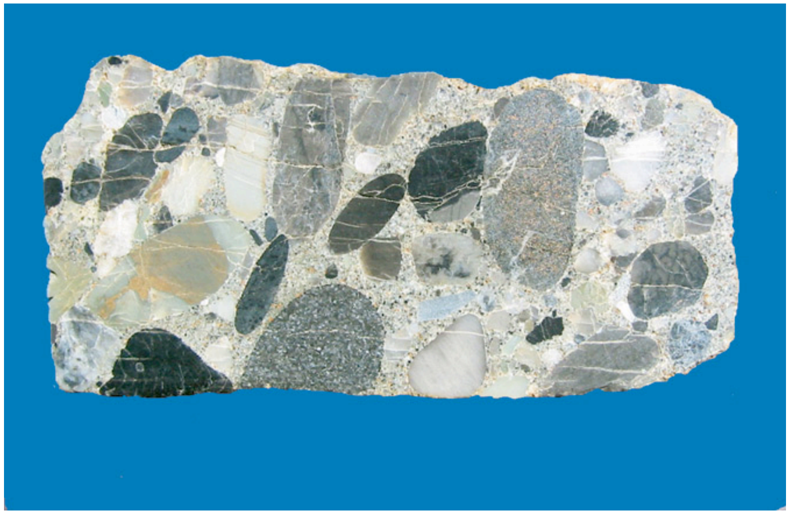


- **Stream sediments.**
- **Lake sediments.**
- **Glacial sediments.**
- **Eolian (wind blown) sediments.**
- **Deltaic sediments**.
- **Estuarine sediments**
- **Beach sediments**.
- **Offshore sediments.**
- **Carbonate shelves.**
- **Marine evaporate basins.**
- **Deep-sea fans.**
- **Deep-sea oozes.**

Sediments to Rocks

- ***Burial***-
  - compaction- loss of ***Porosity***
  - ***Permeability*** (connected space)
- ***Lithification*** (turning sediments to rock)
  - mud == shale
  - sand == sandstone
  - gravel == conglomerate
  - lime mud == limestone
  - silica oozes == chert

- Cementation
  - Silica or carbonate
- Recrystalization.
  - less stable minerals recrystallize into more stable forms.
    - The mineral aragonite in the skeleton of living corals recrystalizes to its polymorph calcite.
- Chemical alteration.
  - In the presence of oxygen, organic remains are quickly converted to carbon dioxide and water.
  - If oxygen is lacking (reducing or anaerobic environment), the organic matter does not completely decay but instead may be slowly transformed to solid carbon.



Limestone, CO_2, And Global Climate Change

- Carbon dioxide is one of the most important greenhouse gases.
- Periods of high CO_2, well above today's value, occurred in intervals from about 550-390 and 180-90 million years ago.
- These intervals, corresponding to much of the early Paleozoic and late Mesozoic eras, are well known for their extensive limestone formation.

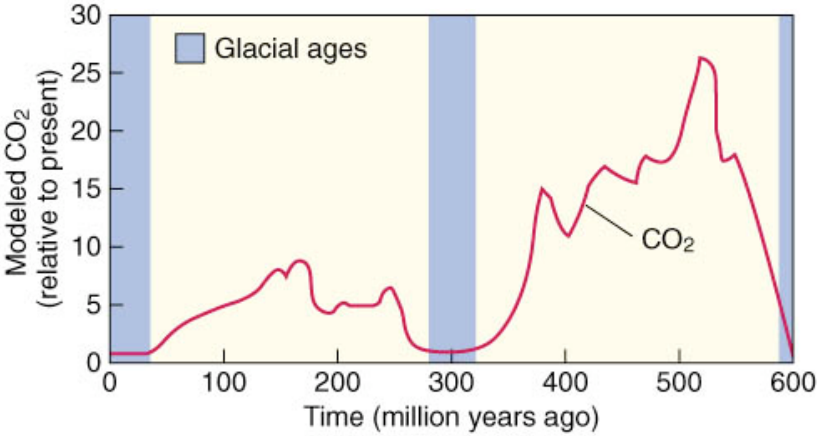


Plate Tectonics

- Sedimentary environments of:
  - Passive Margins
  - Active Margins