Primer on Sedimentary Rocks

Principles applicable to Sedimentary Rocks

**Principle of Uniformitarianism** - physical and biological processes observed today operated in much the same way in the past; involves **gradualistic** and **catastrophic** processes

**Principle of Original Horizontality** - all strata deposited at the earth's surface was originally horizontal

**Principle of Superposition** - successively higher strata are progressively younger

**Principle of Faunal Succession** – Once a fossil species disappears from the rock record (goes extinct), it will not reappear at a younger time.

**Definition**: Compacted and cemented accumulations of sediment, which can be of two general types - clastic and chemical.

**Clastic Sedimentary Rocks** - composed of fragments of pre-existing rock that have been weathered, eroded and transported by wind, water, ice, or mass movement to a site of deposition.

**Distinguishing Characteristics**:
- **Grain Size** - mud/clay, silt (<0.06mm), fine sand (0.06-0.25mm), coarse sand (0.25-2.0mm), pebbles (2-64mm), cobbles (64-256mm), boulders (>256mm); particle size reflects **energy** (velocity) of the transport and depositional system.
- **Sorting** - Well-sorted sediment indicates prolonged reworking by wind or water; poorly sorted sediment may indicate rapid deposition, or deposition by ice or mass movement.
- **Angularity/Roundness and Shape** – Well rounded sediment also indicate prolonged reworking by transporting agent; the shape of grains often indicates the transport system, but also may be related to the type of mineral or rock fragment.
- **Compositional Maturity** - mature sediment contains only Quartz and Clay and reflects prolonged weathering of the source rocks. Immature sediment contains other minerals or rock fragments that may imply mostly mechanical weathering in the source region and short transport distance.
- **Bedding/Stratification** - Sediments transported by water and wind are typically bedded (or stratified) due to fluctuations in the velocity of transport and sediment load. **Graded bedding** is a gradual change from coarse particles at the base to fine particles at the top of a bed that reflects a gradual decrease in the energy of the depositional environment. **Cross-bedding** forms by dune migration in fluvial (stream), marine, or eolian environments. Sediment transported by ice or mass movement are typically unbedded (massive).

**Types of Clastic Sediments & Environments of Formation**:
- **MUDSTONE/SHALE** - Well-sorted, mature, clay-sized particles; generally implies deposition into quiet water
- **SANDSTONE** - Well-sorted, mature, commonly bedded, sand-sized particles typically transported by wind or moderate water movement (e.g. rivers, beaches)
- **GREYWACKE** - Moderately sorted, immature, clay- to sand-sized particles commonly showing graded bedding. Commonly deposited in deep waters off mountainous coasts.
- **CONGLOMERATE** - Poorly sorted, immature, clay to boulder-sized particles transported only a short distance from their source and typically deposited by fast moving water.
- **TILL** - Very poorly sorted, clay to boulder-sized particles; non-bedded; deposited from glaciers.
**Chemical Sedimentary Rocks** - composed of minerals precipitated from water (usually ocean water) due to evaporation or to the metabolic action of organisms (biogenic).

**IRON-FORMATION** - Iron oxide minerals, usually magnetite (taconite ore) or hematite (natural ore), interlayered with chert (microcrystalline quartz) and clay minerals. Common chemical sedimentary rock biogenically formed in shallow marine environments older than about 1.8 billion years.

**LIMESTONE** - Calcium carbonate (calcite) typically composed of abundant marine fossils. Most common type of chemical sediment forming today by biogenic processing of seawater. **Dolomite** (or dolostone) is created by replacement of calcium by magnesium after shallow burial of limestone. Forms in tropical shallow marine environments.

**EVAPORITE DEPOSITS** (Gypsum, Halite, Anhydrite) – mineral precipitated from saline water in arid environments with high evaporation rates (e.g., playa lakes)

**PEAT/COAL** – Carbonaceous material created by the accumulation, compaction and heating of organic matter. Forms in temperate to tropical, low energy, terrestrial environments (lagoons, floodplains).

**Depositional Environments**
- Glacial (continental and alpine)
- Fluvial (rivers and stream)
- Lagoonal (low-lying near-shore terrestrial)
- Lacustrine (lake)
- Deltaic/Estuary (river-ocean interface)
- Eolian (desert, barrier island)
- Marine Shoreline (wave-affected ocean bottom)
- Tidal (tide-affected shoreline)
- Carbonate Shelf (tropical reef)
- Deep Marine (below wave base)