

Chapter 7 notes – Sedimentary rocks

- sedimentary rocks are formed from pre-existing rocks and reveal the history of the Earth by their deformation during mountain bldg, unconformities when exposed, etc.
- sediments can: (1) be a fragment of a rock or mineral, (2) precipitate directly from water, (3) shells of marine organisms
- sedimentary rocks are formed at or near the surface by: (1) mineral precipitation, (2) skeleton of organisms (that have extracted ions from seawater to make shells), (3) lithification of shell fragments or loose grains from preexisting rocks
- sedimentary rocks form a veneer or thin cover over older igneous and metamorphic basement rocks
- sediments and sedimentary rocks cover > 80% of Earth's surface
- weathering is the process of breaking up and chemical decomposition of existing solid rock transforming it into sediment
 - physical weathering (aka mechanical weathering)
 - jointing due to < pressure as rocks are exposed to surface elements due to erosion
 - granite > exfoliation and vertical jointing
 - sedimentary rocks > vertical jointing
 - frost wedging
 - root wedging
 - salt wedging
 - thermal expansion
 - chemical weathering
 - dissolution (^ w/acidity) - dissolves
 - hydrolysis – chemically reacts with minerals, ultimate result = clay
 - oxidation – loss of electrons (i.e. rusting)
 - hydration – H₂O absorbs into crystalline structure of a mineral causing shrink/swell characteristics
 - minerals vary in their weathering rates depending on the crystal structures and chemical composition
 - quartz is very resistant to weathering because of the silica tetrahedron linkages
 - chemical weathering induced by organisms
 - plant roots, fungi, lichens, mineral-eating bacteria
- differential weathering
 - overhangs, valleys, cliff structures

- What is soil?
 - Soil is part of the regolith (unconsolidated material)
 - Soils have horizons, caused by various factors (time, vegetation, ppt, bedrock, topography)
 - Zone of leaching (eluviation)
 - Zone of accumulation (illuviation)
 - O horizon – organic layer
 - A horizon – particles are washed down from this layer into the
 - B horizon – clays accumulate here
 - C horizon (substrate/country rock)
- sedimentary rocks – 4 basic types
 - clastic (detrital) – made up of cemented fragments
 - biochemical – shells of organisms
 - organic – rocks made up mostly of C (ex: coal)
 - chemical – rocks that precipitate directly from water
- clastic sedimentary rocks
 - grains become stuck together and form a mass by:
 - weathering
 - erosion – implies movement
 - transportation (sorting occurs here)
 - deposition
 - lithification
 - compaction – drives H₂O out
 - cementation – cement matrix between grains
- types of clastic rocks – classified by grain size
 - breccia (sharp-edged fragments) – very coarse
 - conglomerate (rounded fragments or clasts)
 - arkose – former sandbars with a mix of quartz and feldspar - coarse
 - sandstone – mostly quartz
 - siltstone – very fine grained sand and mud - fine
 - shale – very fine
 - mudstone
 - graywacke – marine origin
- classifying clastic sedimentary rocks
 - mineral composition
 - grain size
 - grain shape
 - sorting
 - sphericity – how round is a clast
 - angularity – how pointed are the grains
- biochemical and organic sedimentary rocks
 - biochemical
 - organisms can extract ions from seawater to make their shells, usually from calcium carbonate and sometimes dissolved silica

- when these organisms die, their shells sink to the ocean bottom and eventually can form, under the right conditions, biochemical sedimentary rocks. The soft parts (i.e. flesh) of these tiny marine organisms can eventually form oil deposits.
 - example: limestone, made from calcite from organisms or coral reefs
 - fossiliferous limestone – you can see fossils in this type of limestone
 - chalk – made up of plankton shells
 - limestone subject to recrystallization – ions are rearranged into new crystals
 - chert – can be biochemical in origin made from ancient plankton shells
 - organic sedimentary rocks – origins: plant matter subject to great heat and pressure at depth in the earth that drove off volatiles and concentrated the C, ex: coal, shale
 - oil shale is a mixture of mud and plankton bodies (>50% organic matter)
 - chemical sedimentary rocks – do not contain clasts nor do they need to undergo lithification
 - evaporites – as H₂O evaporates, first gypsum forms (80% H₂O gone) then halite (90% H₂O gone)
 - travertine (limestone) – calcite precipitation out of hot water
 - dolostone – calcite replacement in limestone with magnesium-rich groundwater. Process is called diagenesis.
 - Replacement chert – dissolved silica replacing calcite crystals
 - Chert can appear in unusual and striking forms: jasper, agate, also petrified wood and flint
 - sedimentary structures
 - layering – bedding and stratification
 - bed – has top and bottom, can appear as bands across a cliff face or roadcut
 - bedding plane – boundary between 2 beds
 - a sequence of beds is called stratification or bedding. If extensive across a region it is called a formation.
 - bedding forms because of changes in sediment deposition (i.e. sediment source, climate, water depth, flood events)
 - cross bedding – depends upon deposition in a current (of either water or air)
 - graded beds – from turbidity current – as it slows, coarse settles out first, lastly fines
 - bed surface markings – reveal environment at time of deposition
 - ripple marks
 - mud cracks
 - fossils
 - sedimentary environments

- beaches
- sand dunes – produce well-sorted sandstone
- glacial – unsorted glacial till
- river – ripple marks, floodplain > mud cracks, little feldspar, instead we have the result of weathering of feldspar > clays
- deep sea
- coastal – turbidity currents,
- mountain fronts – alluvial fan (feldspar hasn't weathered away, can lithify into coarse grained sed. rocks like arkose and conglomerate)
- redbeds – reddish, Fe-rich, oxidized (from exposure to air) sedimentary layers
- marine sedimentary environments
 - deltas – sediments settle out as river's mouth where it empties into the sea leaving a distinct pattern. Topset beds over foreset beds over bottomset beds.
- coastal beach sands – well sorted, successive layers, ripple marks
- shallow-marine clastic deposits – deposited offshore. Fine-grained, well-sorted, well-rounded silts with remnants of marine organisms such as molluscs and worms. No mud cracks, ripple marks or terrestrial fossils.
- Shallow-water carbonate environments – mostly shells of organisms. Ideal environments of this type are tropical islands > yield fossiliferous limestone
- Deep marine depositional environments – turbidity currents > submarine fan – graded beds of graywacke
- Types of basins
 - Rift basins – form over continental rifts
 - Passive margin basins
 - Intracontinental basins – rifting that ceased, interior of continents, i.e. Illinois, Michigan
- transgression and regression
 - sea level rises (transgression) and falls (regression), alternately burying and exposing sediments. Exposed sediments lead to an incomplete geologic record because of erosion.
 - In the past 545 million years, 6 major transgressions and regressions have occurred in the North American interior