Volcanoes

- Volcano Types
  - Stratovolcanoes
    - Large, cone-shaped volcano
    - Composed of alternating layers of lava and tephra
  - Shield Volcanoes
    - Broad, slightly domed-shaped (like an inverted shield)
    - Made by lateral flow of low-viscosity basaltic lava
    - Have a low slope and cover large geographic areas
    - Mauna Loa on Hawaii
  - Cinder Cone – conical piles of tephra

- Eruptions to Remember
  - Mt. St. Helens – May 18, 1980 – 8:32 p.m.
    - The blast devastated 600 km squared and killed 61 people
    - Lahars plugged the Toutle River – closed the Columbia
    - Ash fell in North Dakota – highways and rail lines stopped
    - Destroyed timber valued at several 100 million dollars
    - One side erupted, rather than erupting straight up

- Volcanic Hazards
  - Earthquakes
  - Tsunamis – water explosions create giant waves

- Mitigating Hazards
  - Danger assessment maps
    - Delineate danger areas
      - Pyroclastic flows, lahars

- Eruptive Style
  - Effusive eruptions – produce lava flows
    - Can produce huge lava fountains
    - Commonly basaltic, lead to formation of shield volcanoes
    - Pele's hair and tears, bombs
  - Basaltic Lava Flows
    - Pahoehoe vs A'a
      - Pahoehoe – a Hawaiian word describing basalt with a glassy, ropy texture
        - Forms when extremely hot basalt forms a skin
      - A'a – is a Hawaiian word describing basalt that solidifies with a jagged, sharp, angular texture
        - Forms when hot flowing basalt cools and thickens
    - Underwater, basalt cools instantly; it cannot flow
    - It cools to form a rounded blob called a pillow
    - Common on the mid-ocean ridge

- Continental Hot-Spot Volcanoes
  - Continental hot-spot – cutes a continental plate
    - Yellowstone – erupted and created a caldera

- Flood Basalt Eruptions

- Voluminous lava eruptions above a plume

Sedimentary Rocks

- Sedimentary Rocks
  - Sediments are the building blocks of sedimentary rocks
  - Sediments are diverse, as are the rocks made from them
  - 4 classes:
    - Clastic – made from weathered rock fragments (clasts)
    - Biochemical – cemented shells of organisms
    - Organic – the carbon-rich remains of plants
    - Chemical – minerals that crystallize directly from water
  - Clastic Sedimentary Rocks
    - Clastic sedimentary rocks reflect several processes
      - Weather – generation of detritus via rock disintegration
      - Erosion – removal of sediment grains from rock
      - Transportation – dispersal by wind, water, and ice
      - Deposition – settling out of the transporting fluid
      - Lithification – transformation of loose sediment into solid rock
        - Burial, compaction, cementation
    - Classified on the basis of texture and composition
      - Clast (grain) size – the average diameter of clasts
        - Range from very coarse to very fine
        - Boulder, cobble, pebble, sand, silt, clay
        - With increasing transport, average grain size decreases
      - Clast composition – the mineral makeup of sediments
        - May be individual minerals or rock fragments
        - Mineral identities provide clues about…
          - The source of the sediment
          - The environment of deposition
      - Angularity and sphericity – indicate degree of transport
        - Grain roundness and sphericity increases with transport
          - Well-rounded – long transport distances
          - Angular – negligible transport
      - Sorting – the uniformity of grain size
        - Well-sorted – uniform grain sizes
        - Poorly sorted – wide variety of grain sizes
        - Sorting becomes better with distance from the source
    - Character of cement
      - Cement – minerals that fill sediment pores
      - Common cements;
        - Silica
        - Calcite
        - Hematite
        - Clay minerals
    - Coarse clastics – composed of gravel-sized clasts
      - Breccia – composed of angular fragments
        - Angularity indicates a lack of transport processing
        - Deposited relatively close to source
      - Conglomerate – comprised of rounded gravel

        - Indicates water transport
            - Clasts bang together forcefully in flowing water
            - Collisions round angular corners and edges of clasts
        - Conglomerates are deposited at a distance from the source
    - Sandstone – clastic rock made of sand-sized particles
        - Forms in many depositional settings
        - Quartz is, by far, the dominant mineral in sandstones
        - Sandstone varieties
            - Arkose – contains abundant feldspar
            - Quartz sandstone – almost pure quartz
- Fine clastics – composed of silt and clay
    - Silt-sized sediments are lithified to form siltstone
    - Clay-sized particles form shale
- Chemical Sedimentary Rocks
    - Comprised of minerals precipitated from water solution
    - Evaporates – created from evaporated seawater
        - Evaporation triggers deposition of chemical precipitates
        - Examples include halite (rock salt) and gypsum (dry wall)
    - Travertine – calcium carbonate ($CaCO_3$) precipitated from groundwater where it reaches the surface
        - Dissolved calcium reacts with bicarbonate
        - CO_2 expelled into the air causes $CaCO_3$ to precipitate
    - Dolostone – limestone altered by Mg-rich fluids
        - Looks like limestone, except…
            - It has a sugary texture and a pervasive porosity
            - It weathers to a buff, tan color
    - Replacement chert – nonbiogenic in origin
        - Many varieties
            - Flint – black or gray from organic matter
            - Jasper – red or yellow from Fe-oxides
            - Petrified wood – wood grain preserved by silica
            - Agate – concentrically layered rings
- Biochemical and Organic Rocks
    - These are sediments derived from living organisms
        - Biochemical – hard mineral skeletons
            - Biochemical limestone – $CaCO_3$ skeletal (shell) remains
                - Warm, tropical, shallow, clear, O_2-rich, marine water
                - Diverse organisms (plankton, corals, clams, snails, etc.)
                - Many textural varieties
            - Chert – rock made of cryptocrystalline quartz
                - Formed from opalline silica (SiO_2) skeletons
                    - Diatoms
                    - Radiolarians
                - Opalline silica added to bottom sediments dissolves
                - Silica pore fluids solidify to form chert nodules or beds
        - Organic – cells of plants, algae, bacteria, and plankton
            - Made from organic carbon
                - Coal – altered remains of fossil vegetation
                - Oil shale – shale with heat altered organic matter
- Flint continued…