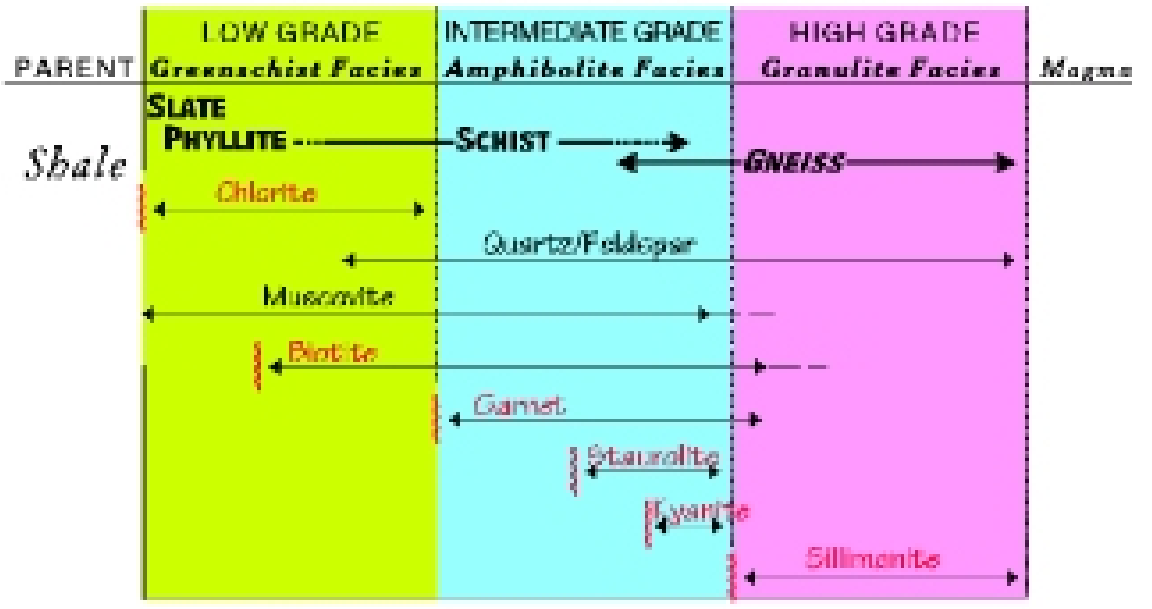
LECTURE 6

- Geology in the news
  - Kilauea eruption threatening homes and roads in Hawaii
  - Not usually active
- Metamorphism
  - Intro
    - Contain a lot of unusual materials
    - Not all properties found in every rock
    - Tell us a lot about temp and pressure conditions
    - Explain a lot of unusual features
    - Metamorphism is a very slow process
  - Causes of metamorphism
    - Temperature
      - Geothermal gradient
        - How fast is the temp rise with depth
      - Avg 30 C/km
      - Typical range: 20-60 C/km
      - Putting rock into oven and cooking it
      - Metamorphism via heat
        - Contact metamorphism
          - Increase temp until transform into meta rock
            - Magma
            - Only rocks close to the heating magma
    - Pressure
      - Pascals and bars (units to measure pressure)
      - 1 bar = atmospheric pressure at surface (standing outside)
      - Pressure gradient: ~ 300 bar/km depth
      - Confining pressure
        - Exerting pressure evenly in all directions
      - Directed pressure (differential)
        - 1 dominant direction of where the pressure comes from (top and bottom)
      - Most meta rocks form at 10-30 km in depth (mid lower crust)
    - Exposure
      - How do metamorphic rocks get back to the surface?
        - Brought back to surface as layers
        - Faults (rocks shift by each other)
    - Metamorphism via pressure
      - Regional metamorphism
        - Pressure is number 1 factor that causes the metamorphic rock
        - Large scale
    - Other metamorphic types
      - Fault metamorphism
        - As rocks moves along fault lines, causes changes in the rocks
    - Metamorphism via fluid
      - Metasomatism
        - Induce metamorphic change with hot fluids cause the change
      - Ore deposits

        - Deposit that has high concentration of something valuable
    - Seafloor metamorphism
        - Metasomatism throughout the seafloor
        - MOR
        - Heating with hot fluids along the sea floor
- Rocks and environments
    - Parent rock's composition is key
        - Same temp and pressure increase
            - Shale to slate
    - Metamorphic change
        - Grade
            - How much alteration occurred
            - Low grade, intermediate grade, high grade
            - Temp combinations based on grade
        - Index minerals
            - Range of conditions
            - Make up rock



- Facies
    - Blueschist facies: glaucophane, lawnsonite, epidote
    - Overlapping
    - How and where did the rock form
    - 7 major facies
        - Zeolite, blueschists, greenschist, hornfels, granulite, eclogite
    - Uses facies info to reconstruct how metamorphism occurred
    - Blueschist facies - pressure and not so much temp
- Length of metamorphism
    - Prograde
        - Burial and heating
        - Part of rocks history where high temp increase phase of that rock
    - Retrograde
        - Decompression and cooling
        - Low temp but building pressure
    - Max temp = peak of metamorphism
    - Changes within minerals can record pressure/temp changes
- Types of metamorphic rocks

- Foliated (sheet like structure)
    - Slate
        - Small minerals
    - Schist
        - Larger minerals present
    - Gneiss ('nice')
        - Alternating light and dark bands
- Non foliated (no sheets)
    - Hornfels
    - Quartzite
        - Lots of quartz
    - Marble
        - Lots of calcite