

## 5 Igneous Rocks

- 1) The Rock Cycle – **Not covered in class at this time, but Please review**
  - a) Rock – a consolidated mixture of minerals
  - b) 3 types
    - i) Igneous – formed from magma
    - ii) Sedimentary – formed from weathering products or organic processes
    - iii) Metamorphic – formed from rock subjected to temperature &/or pressure
- 2) Overview of Igneous Rocks
  - a) Form when minerals crystallize from magma
  - b) Intrusive → Plutonic
  - c) Extrusive → Volcanic
  - d) Magmas derived from below the Earth's surface in the mantle
  - e) Magma is hot and buoyant
- 3) Igneous Rock Classification
  - a) Intrusive
    - i) Formed within the Earth
    - ii) Magma
    - iii) Reach Surface by uplift and erosion of the Earth's Crust
  - b) Extrusive
    - i) Formed at the Surface
    - ii) Lava
- 4) Texture
  - a) Related to the cooling history of the rock
  - b) Really Fast = no grains → glassy
    - i) Very rapid cooling
    - ii) Ions do not have time to form crystalline structures
  - c) Fast = Fine (small) - grained → aphanitic
    - i) Fine (small) – grained
    - ii) Cooled quickly
    - iii) Crystallized at the Earth's surface
  - d) Slow = Coarse (large) - grained → phaneritic
    - i) Coarse (large) – grained
    - ii) Cooled slowly
    - iii) Crystallized within the Earth
  - e) Complex = Mixture → porphyritic
    - i) Porphyritic Aphanitic
    - ii) Porphyritic Phaneritic
    - iii) Two stages of cooling
    - iv) 1<sup>st</sup> cooled slowly within the Earth (larger crystals - Phenocrysts)
    - v) 2<sup>nd</sup> cooled faster but still slow enough that crystals fully develop – within the Earth (coarse-grained matrix) or 2<sup>nd</sup> cooled rapidly on the Earth's surface (fine-grained matrix)
  - f) Vesicular: trapped gases in lava
  - g) Pyroclastic: ash and rock fragments formed explosively
    - i) Pyroclastic – welded shards of rock & ash ejected from a vent during an eruption
- 5) Composition of Igneous Rocks
  - a) Silica (SiO<sub>2</sub>) is primary ingredient of all magmas
  - b) Viscosity: Resistance to flow
    - i) Silica content
    - ii) temperature
  - c) Composition—Silica Content

- i) Felsic: *Feldspar & Silica* – >65% silica → High Viscosity (Like Honey)
  - ii) Intermediate – 53-65% silica → Intermediate Viscosity
  - iii) Mafic: *Magnesium and Iron (Fe)* - 5-52% silica → Low Viscosity
  - iv) Ultramafic – <45% silica → Very Low Viscosity (Like Water)
- d) Composition – Temperature of origin
- i) Felsic
    - (1) <900°C; Na, K, Al-rich
    - (2) Light colored
  - ii) Mafic:
    - (1) >1100°C; Ca, Fe, Mg-rich
    - (2) Dark Colored
  - iii) Intermediate:
    - (1) 900-1100°C; Na, Al, Ca, Fe, Mg, K
    - (2) Salt & Pepper appearance
  - iv) Ultramafic:
    - (1) ~1400°C; very Ca, Fe, Mg-rich
- 6) Bowen's Reaction Series
- a) Different minerals crystallize from magmas at different temperatures
  - b) How does this relate to the main silicate structures?
- 7) Magmatic Differentiation - Formation of more than one magma from a single parent magma
- a) **Crystal Settling:**
    - i) crystallized minerals have a density greater than the magma and settle to the bottom due to gravity
    - ii) Because Fe and Mg are first removed, melt becomes rich in SiO<sub>2</sub>, Na, and K
    - iii) Marbles analogy
  - b) **Assimilation**
    - i) magma reacts with the “country rock” which is adjacent to the magma chamber
    - ii) Magma composition is altered according to the composition of the assimilated country rock
    - iii) **Inclusions** are rocks, incompletely melted chunks of country rock
  - c) **Magma Mixing**
    - i) Magmas of different compositions are mixed together
    - ii) Resulting magma is of a composition intermediate between the parents
- 8) Igneous Rock Classification