Metamorphic Rocks

Metamorphism

- *Meta* = change, Greek
- *Morph* = form, Greek
- Metamorphic rocks form from other rocks (**protolith**) by essentially **solid-state** changes in mineralogy and/or texture as a result of a change in chemical and/or physical environment.

Metamorphism is characterized by:

- **phase changes** - growth of new physically discrete, separable components (minerals), either with or without (isochemical) addition of new material; and/or
- **textural changes** - recrystallization, alignment and/or grain size, usually as a result of unequal application of stress

Agents of Metamorphism

- Have been recrystallized as the result of
  - Temperature
  - Pressure
    - Confining pressure (compressive stress)
    - Directed pressure (differential stress), including shearing
  - Chemical Activity
    - the composition of pore fluids

Pore Fluids

- A fluid that occupies the empty spaces between particles
- May come from
  - Partial melting of the rock
  - Groundwater

Metamorphic Processes

- Recrystallization
- New Minerals-Index Minerals
  - Neomorphism: transformation of one mineral into a new one, depending upon its new environment.
  - Metasomatism: metamorphism coupled with the introduction of ions from an external source. (Ex: Water)
- Mineral Orientation
- Mineral Segregation

Metamorphic Processes-How it is Done

- Temperature changes
  - Below 200° not much happens
  - Metastability can occur
  - Migmatite can form from igneous rocks
    - Half igneous, half metamorphic

Pressure Changes

- Makes minerals pack themselves closer (mineral segregation)

Chemically Active Fluids

- Volatiles (H_2O, CO_2) play an important role
  - Source is self contained
- Metasomatism (open system)
  - Usually from an igneous intrusion
  - Hot water
    - Hydrothermal alteration
    - Plays a part in the formation of ores

Effects of Metamorphism

- Foliation
  - Slaty
  - Phyllitic
  - Schistose
  - Gneissic

Classification of Metamorphic Rocks

Foliated Rocks

♦Slate
♦Phyllite
♦Schist
♦Gneiss

Non-Foliated Rocks

♦Marble
♦Quartzite
♦Hornfels
♦Anthracite Coal

Types of Metamorphism

- Contact or Thermal Metamorphism
- Regional or Dynamothermal Metamorphism

Metamorphic Facies

- Facies =set of characteristics that distinguish a rock
  - Hornfels
  - Zeolite
  - Blueschist
  - Greenschist
  - Amphibolite
  - Granulite
  - Eclogite
  - Migmatite
  - (Magma)

Insert your beautiful diagram here: