Essentials of Geology

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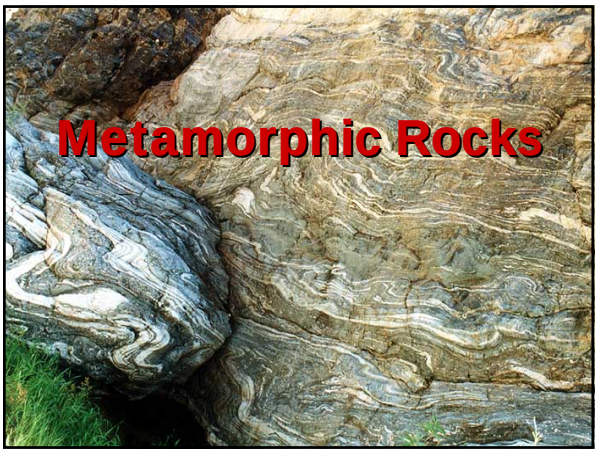
Chapter 7

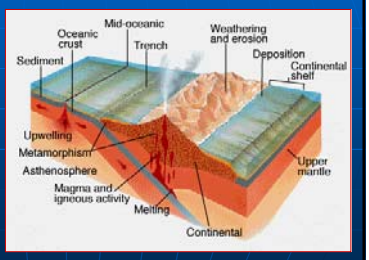


Why Should You Study Metamorphic Rocks?

- Exposed metamorphic rocks make up large parts of continents
- Certain minerals in metamorphic rocks give clues about the conditions existing when they formed
- Used widely as building materials and manufacturing

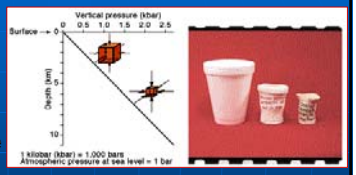
What are the Agents of Metamorphism?

- **Heat**
  - increases the rate of chemical reactions that produce different minerals
- **Heat sources**
  - intrusive magma
  - deep burial along subduction zones



What are the Agents of Metamorphism?

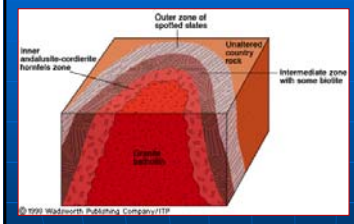
- **Pressure**
  - lithostatic pressure results from the weight of overlying rocks
  - mineral grains are more closely packed
  - recrystallization may occur, producing smaller and denser minerals
  - differential pressure results from unequal forces applied to the rock



What are the Agents of Metamorphism?

- **Fluid Activity**
  - water and carbon dioxide are almost always present in some amount in metamorphic regions
  - these fluids enhance metamorphism by increasing the rate of chemical reactions
- **Fluid Source**
  - water trapped in the pore space of sedimentary rocks
  - volatile magmatic fluids
  - dehydration of water-bearing minerals that are subjected to heat and pressure

What are the Three Types of Metamorphism?

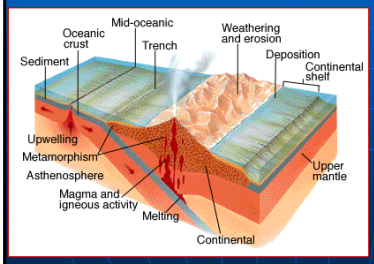


- **Contact Metamorphism**
  - produced when a body of magma alters the surrounding country rock
- **Factors in contact metamorphism**
  - initial temperature and size of the intrusion
  - presence and chemistry of fluids
- **Metamorphic aureoles**
  - zones of mineral assemblages surrounding intrusion

What are the Three Types of Metamorphism?

- **Dynamic Metamorphism**
  - results from high differential pressures
  - most often found near faults
  - mylonites are hard, dense, and fine grained

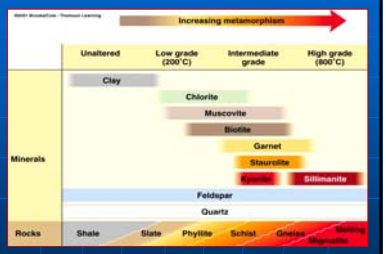
What are the Three Types of Metamorphism?



- **Regional Metamorphism**
  - produces most metamorphic rocks; makes up the shields
  - results from extreme heat and pressure generated by the processes at convergent plate boundaries
  - covers large geographic areas, and usually shows a gradation of deformation corresponding to areas of the most intense heat / pressure

What are the Three Types of Metamorphism?

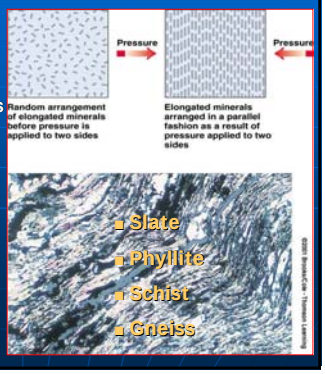
- **Regional Metamorphism**
  - certain minerals are known to form under specific conditions of temperature and pressure - index minerals



  - low, intermediate, and high grades of metamorphism are recognized, based on conditions and the resulting mineral assemblages

How are Metamorphic Rocks Classified?

- **Foliated Metamorphic Rocks**
  - Heat and differential pressure cause minerals to arrange themselves in a parallel fashion called foliation
  - size and shape of crystals determines texture; fine to coarse
  - with increasing grain size, common foliated metamorphic rocks include:

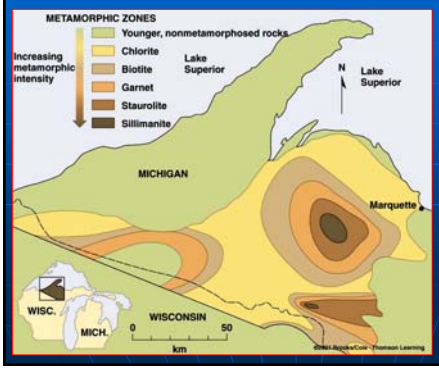


Foliated Textures

How are Metamorphic Rocks Classified?

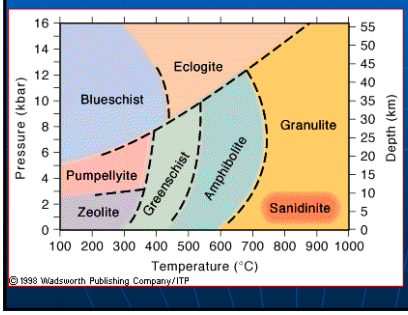
- **Nonfoliated Metamorphic Rocks**
  - minerals do not show a discernible preferred orientation
  - most common are those composed mainly of one mineral - marble or quartzite - or very fine grained textures as in greenstone or hornfels

What are Metamorphic Zones and Facies?



Metamorphic zones in the Upper peninsula of Michigan

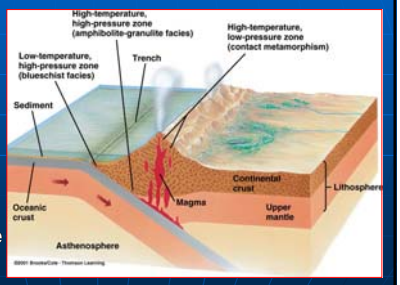
What are Metamorphic Zones and Facies?



- **A pressure temperature diagram shows where various metamorphic facies occur**
  - facies are groups of rocks characterized by mineral assemblages formed under the same broad temperature - pressure conditions

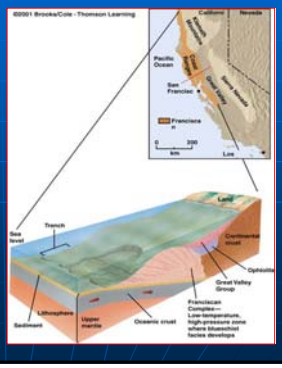
How Does Metamorphism Relate to Plate Tectonics?

- **Convergent boundaries**
  - temperature and pressure increase in collisions
  - several facies are recognized in this model, defined by the temp/pressure conditions



How Does Metamorphism Relate to Plate Tectonics?

- **Convergent boundaries**
  - The Franciscan complex in California is an excellent example of the blueschist facies
  - A former subduction zone is interpreted to have existed here, based on the presence of low-temp, high pressure facies



Metamorphism and Natural Resources

Marble and slate have been produced for centuries

Ores of tin, tungsten, galena, and pyrite are produced by contact metamorphism