

## Chapter 8: METAMORPHIC ROCKS

### ➤ THE THREE ROCK GROUPS

- Igneous rocks: Formed by cooling and consolidation of magma
- Sedimentary rocks: Formed by chemical precipitation of material from water at the Earth's surface, or by deposition and cementation of particles and debris transported by water, wind, or ice
- Metamorphic rocks: Igneous or sedimentary rocks that have been changed under high

temperatures and/or high pressures

### ➤ INTRODUCTION

- Metamorphic – Changed from an original “parent”
  - Meta = Change
  - Morph = Form or shape
- Parent rocks are called “protoliths”
- Metamorphism can occur to any protolith

### ➤ METAMORPHIC PROCESS

- Heating → recrystallization (not melting!!)
- Pressure → tighter arrangement of atoms
- Hot groundwater → Change in chemical composition (ions dissolved or deposited)
- Often initiated by burial

### ➤ METAMORPHISM

- Metamorphism occurs in the solid state
- It doesn't include weathering, melting
- Metamorphics often look totally unlike protoliths

### ➤ EXAMPLES

- Red mudstone
- Garnet gneiss
- Fossiliferous limestone
- Marble

### ➤ METAMORPHIC PROCESSES

- Recrystallization: Minerals change size & shape
  - o Quartz siltstone → Large quartz crystals
- Plastic Deformation
  - o Quartz sandstone → Wavy pancakes

### ➤ CAUSES

- The agents of metamorphism are...
  - Heat
  - Pressure
  - Differential stress
  - Hydrothermal fluids
- Not all agents are required; they often co-occur
- Rocks may be overprinted by multiple events

### ➤ METAMORPHIC ROCK TYPES

- Foliated – Has a through-going planar fabric
- Subjected to differential stress

### ➤ METAMORPHIC ROCK TYPES

- Non-foliated – No planar fabric evident

- Crystallized without differential stress
- METAMORPHIC ROCKS
  - Slate – Low-grade metamorphic shale
    - Has a distinct foliation called slaty cleavage
  - Slaty cleavage oriented perpendicular to compression
  - Slate breaks along this foliation creating flat sheets
- METAMORPHIC INTENSITY
  - Different minerals are stable as temperature and pressure change
  - Grade is a measure of metamorphic intensity
    - Low grade – Slight
    - High grade – Intense
- CONTACT METAMORPHISM
  - Occurs when rocks are heated and chemically changed by the intrusion of a body of hot magma
- SUBDUCTION METAMORPHISM
  - Subduction creates the unique blueschist facies. Trenches and accretionary prisms have a low geothermal gradient – low temperature, but high pressures