

# Metamorphism and Metamorphic Rocks

Chapter 6

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## 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

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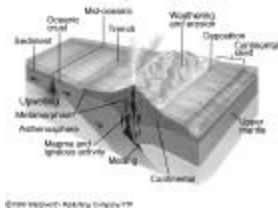
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## What are the Agents of Metamorphism?

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



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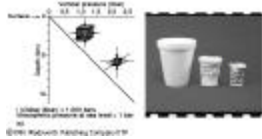
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## What are the Agents of Metamorphism?



### ■ 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

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## 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

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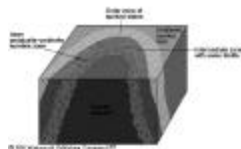
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## What are the Three Types of Metamorphism?



### ■ 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

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## 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




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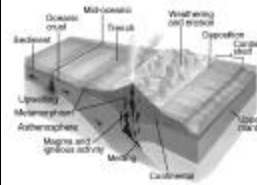
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## What are the Three Types of Metamorphism?

### ■ 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



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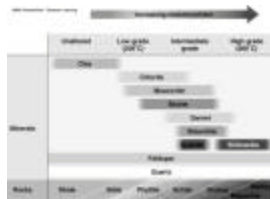
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## What are the Three Types of Metamorphism?

### ■ 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




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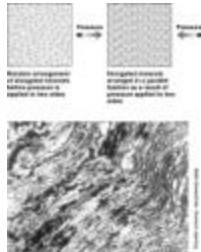
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## How are Metamorphic Rocks Classified?

### ■ 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:

- Slate
- Phyllite
- Schist
- Gneiss



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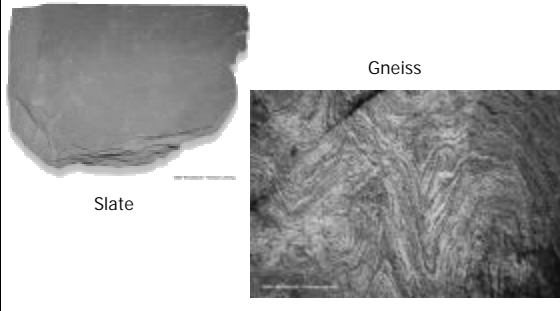
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## Foliated textures



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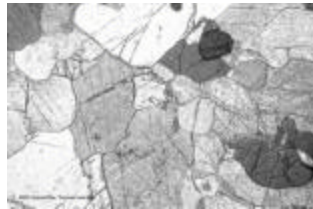
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## How are Metamorphic Rocks Classified?

### ■ 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



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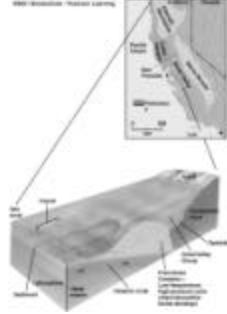
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## How Does Metamorphism Relate to Plate Tectonics?

- 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



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## Metamorphism and Natural Resources

Marble and slate have been produced for centuries



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

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