

G-100

Lecture 14

Metamorphism



Chapter 6 Open  
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Mountains are made out of ?



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## National Slate Museum

You are here: [Home](#) > [National Slate Museum](#)

### National Slate Museum, Llanberis

**"The most Welsh of Welsh industries"**


The National Slate Museum at Llanberis invested a £1.6 million lottery grant into bringing back to life the inheritance of the north Wales slate industry, which rooted the industrial revolution.



The Museum building is sited in the Victorian workshops built in the shadow of Eiddor mountain, site of the vast Dinorwig quarry.

Not so much a museum as a pocket of history, it is as though the quarrymen and engineers have only just put down their tools and left the courtyard for home.

Now, with imaginative interpretation, the remarkable relics of the slate industry can be understood and enjoyed by the many thousands of visitors to this stunning countryside on the flanks of Snowdon. The lottery grant made possible unique features and facilities, which offer the visitor an unparalleled day out in the richly wooded lakeside landscape of the Padarn Country Park. All visitors can now enjoy



**A Guide to the Museum**  
View an online guide to the museum

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### Metamorphism

- Changes in heat, pressure, and the chemical environment of rocks
  - alters mineral composition
  - alters textures of crystals
  - creates metamorphic rocks
- Metamorphic changes occur in the solid state, *no melting*

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### Metamorphism

- Causes
- Types
- Rock textures
- Grade, mineral assemblages
- Facies
- Prograde vs. retrograde P-T pathways

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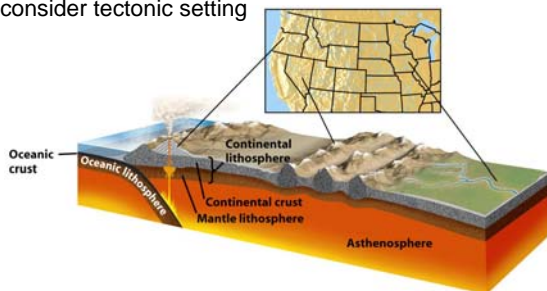
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### Causes of metamorphism

- pressure and temperature increase with depth in all regions
- consider tectonic setting



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- Temperature increase with depth in all regions

- rate =  $20^{\circ}$  to  $60^{\circ}$  C per km
- at 15 km depth:  $450^{\circ}$  C

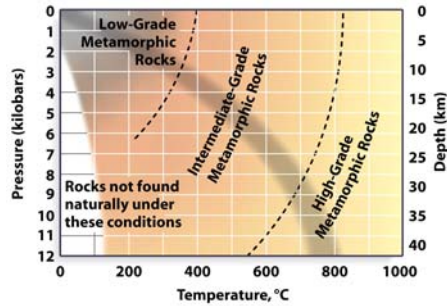


Figure 8-2  
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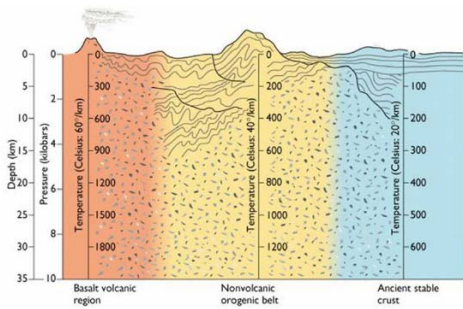
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- Temperature-pressure (depth) relations in different tectonic settings

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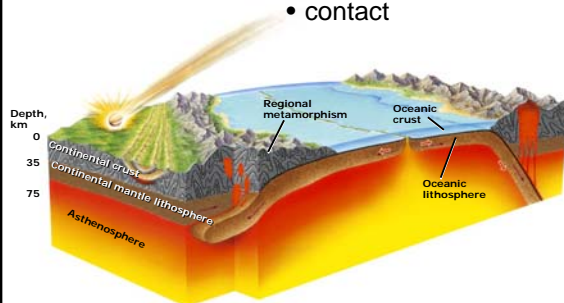
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### Three main types of metamorphism

- “Normal”-regional
- high pressure-regional
- contact




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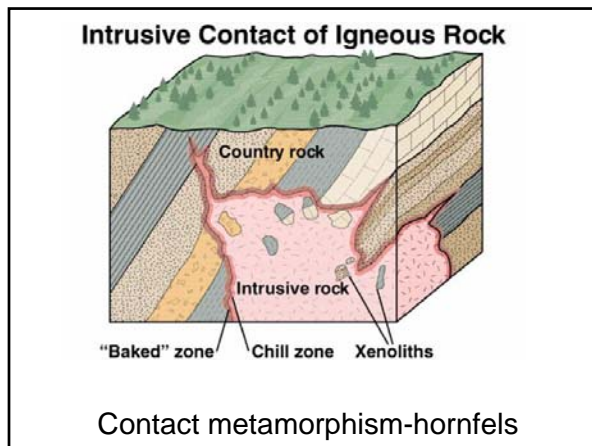
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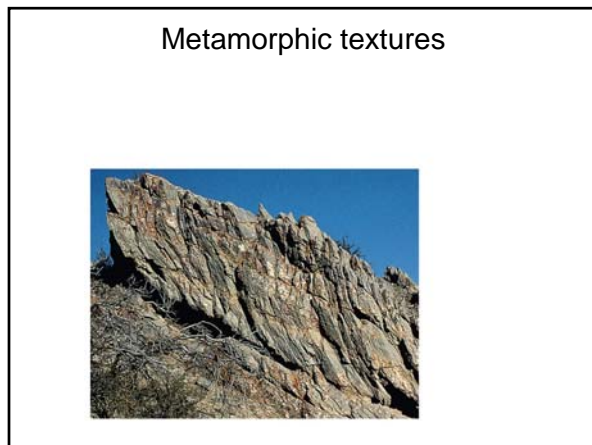
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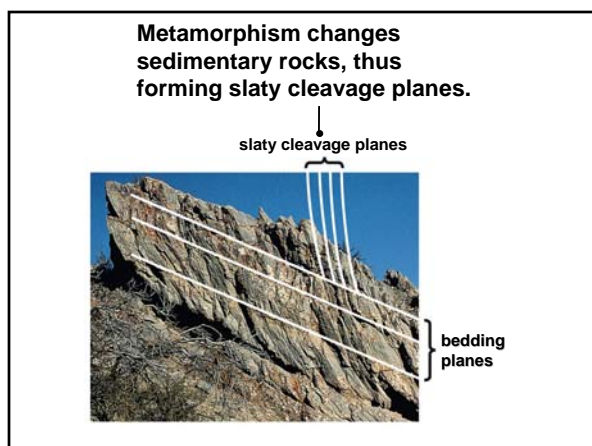
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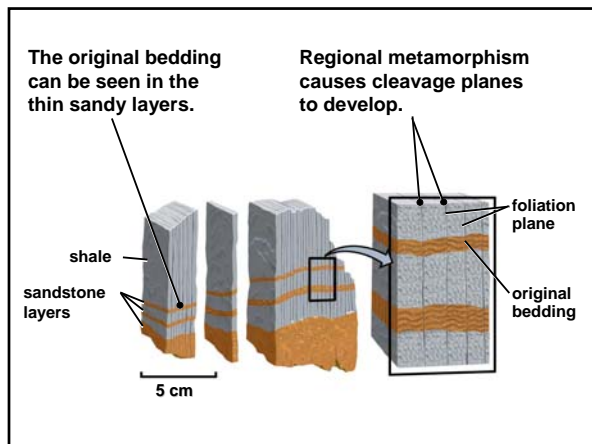
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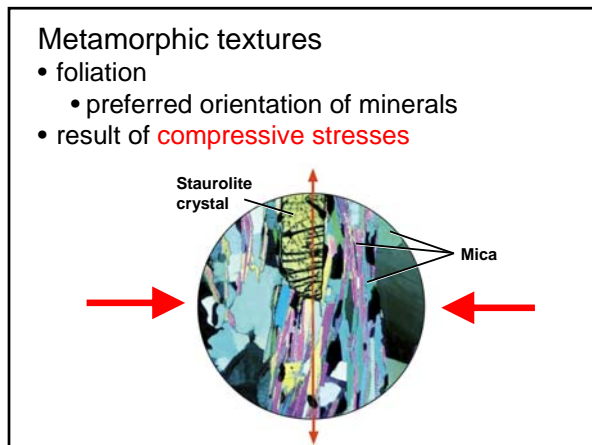
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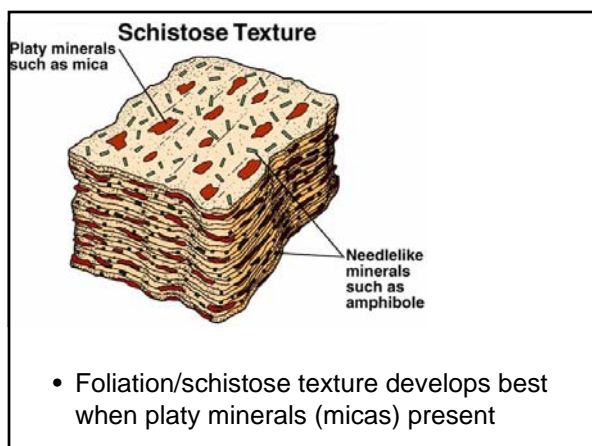
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foliated texture:

Schist, with garnet porphyroblasts



Figure 9-6  
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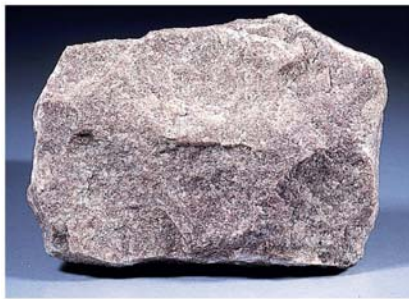
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granoblastic texture:

quartzite: mineral grains of equal size and shape



**Quartzite**

Figure 9-5a  
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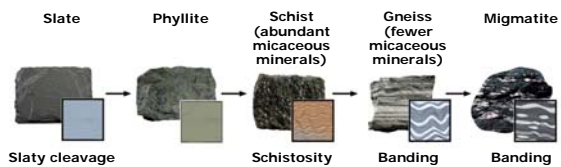
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**Foliated** rocks are classified by the degree of cleavage, schistosity, and banding

Increasing temperature & pressure left to right:



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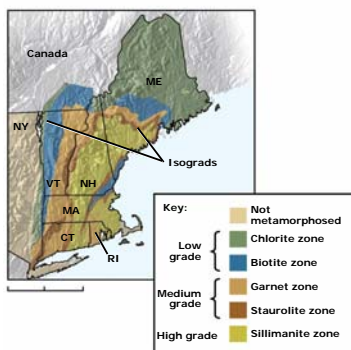
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## Regional metamorphism and metamorphic grade

- mineral isograds
  - index minerals reflect pressure & temperature
- groups of 2 to 3 index minerals define zones of each grade, separated by isograds




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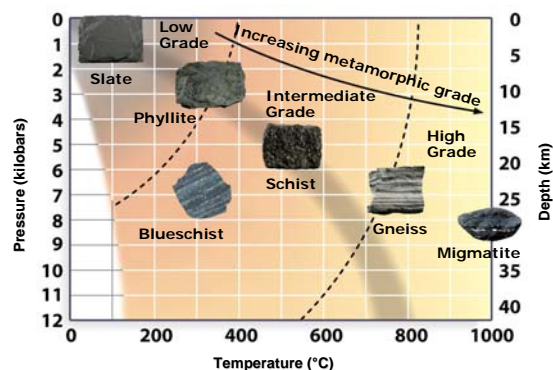
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## Regional metamorphism and metamorphic grade




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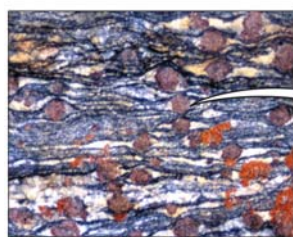
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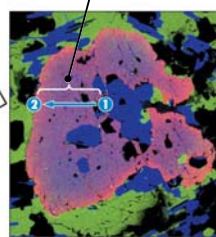
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During metamorphism, a garnet crystal grows, and its composition changes.



thin section of garnet gneiss

Composition of crystal can be plotted on the P-T path as it grows.



growth zone in garnet

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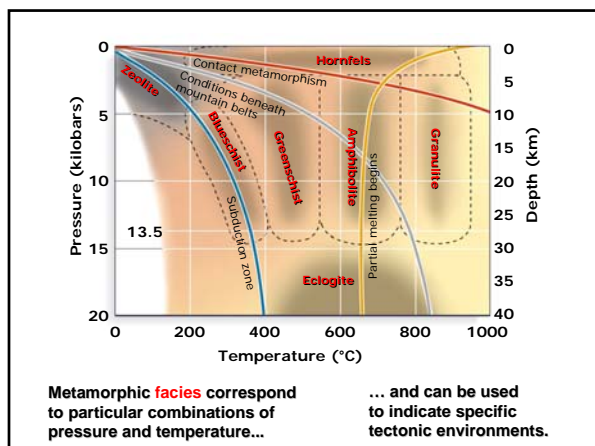
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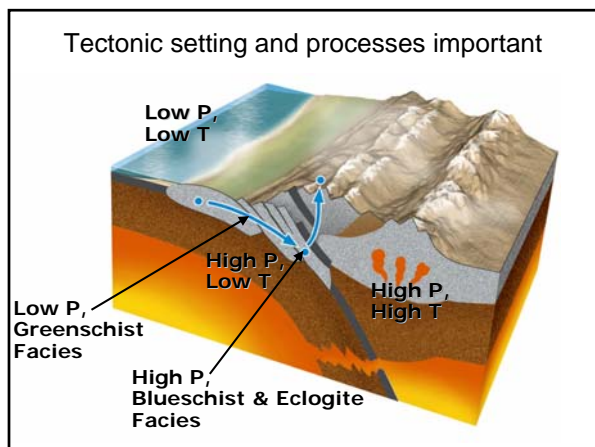
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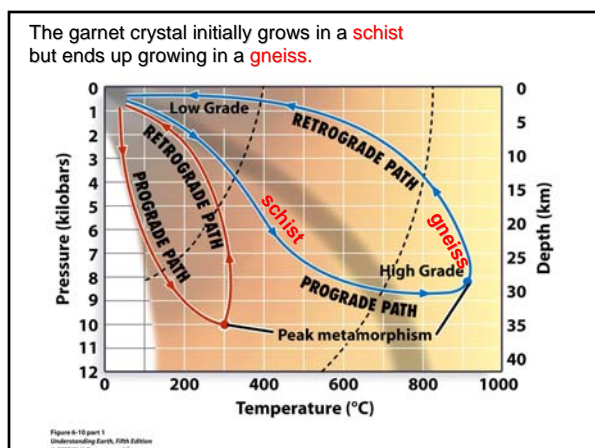
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