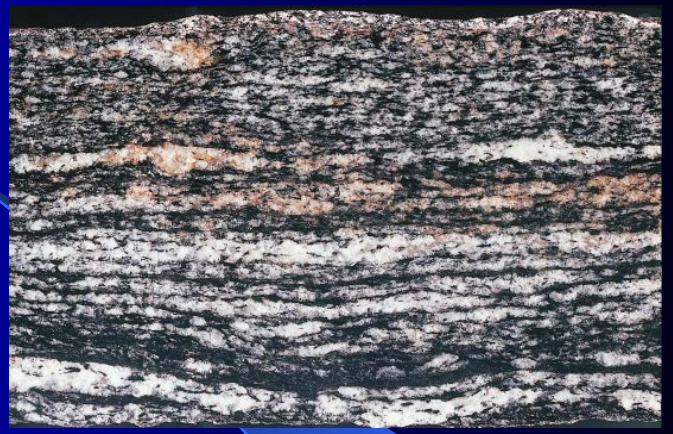
Metamorphic Rocks

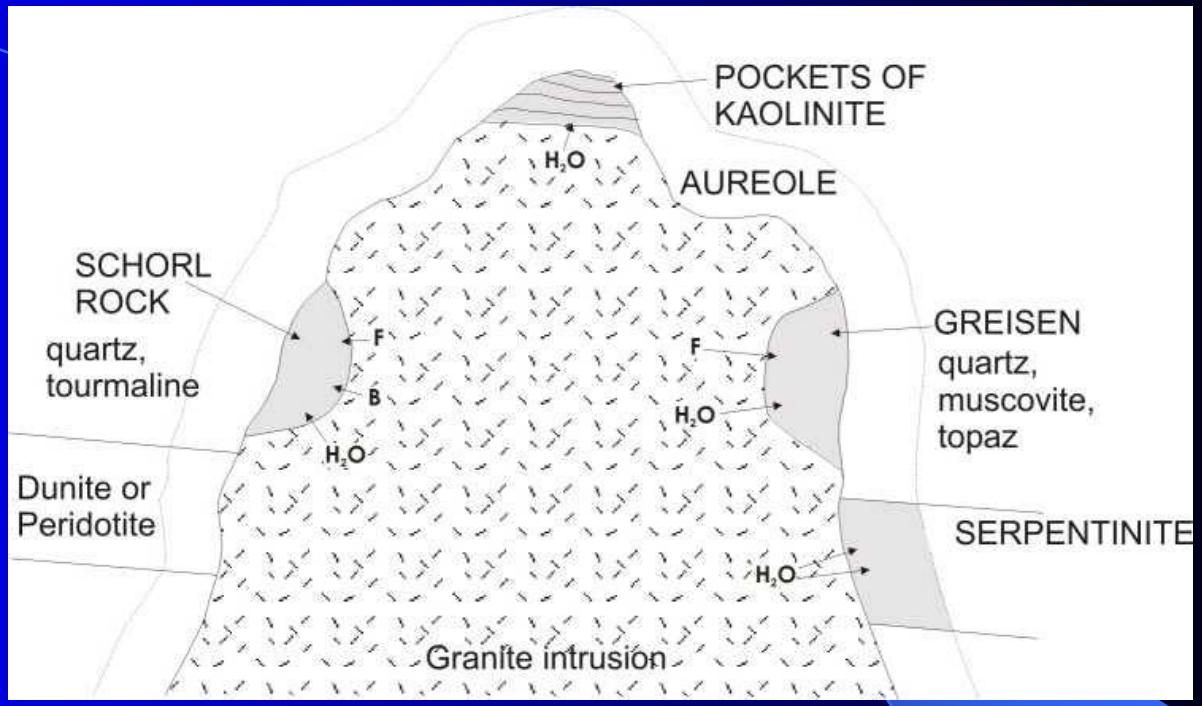


Metamorphic rocks undergo changes in texture, mineralogy, or both while in the solid state

- Low-grade: 150˚C–550˚C and low pressure
- High-grade: above 550˚C and high pressure

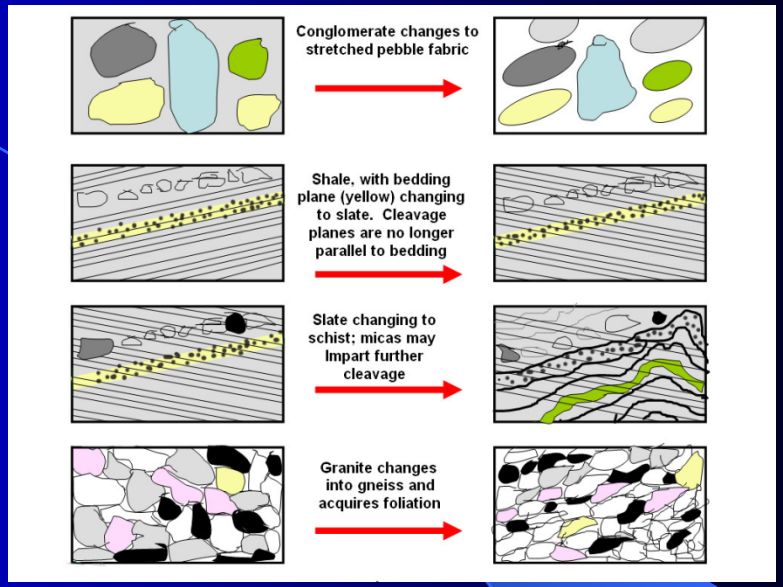
Other factors also play an important role in metamorphism: fluids, time, and stress

Fluids trapped in the pores between rock grains heat up during metamorphism and can speed up chemical reactions. When there are abundant pore fluids involved in metamorphism, it is called metasomatism

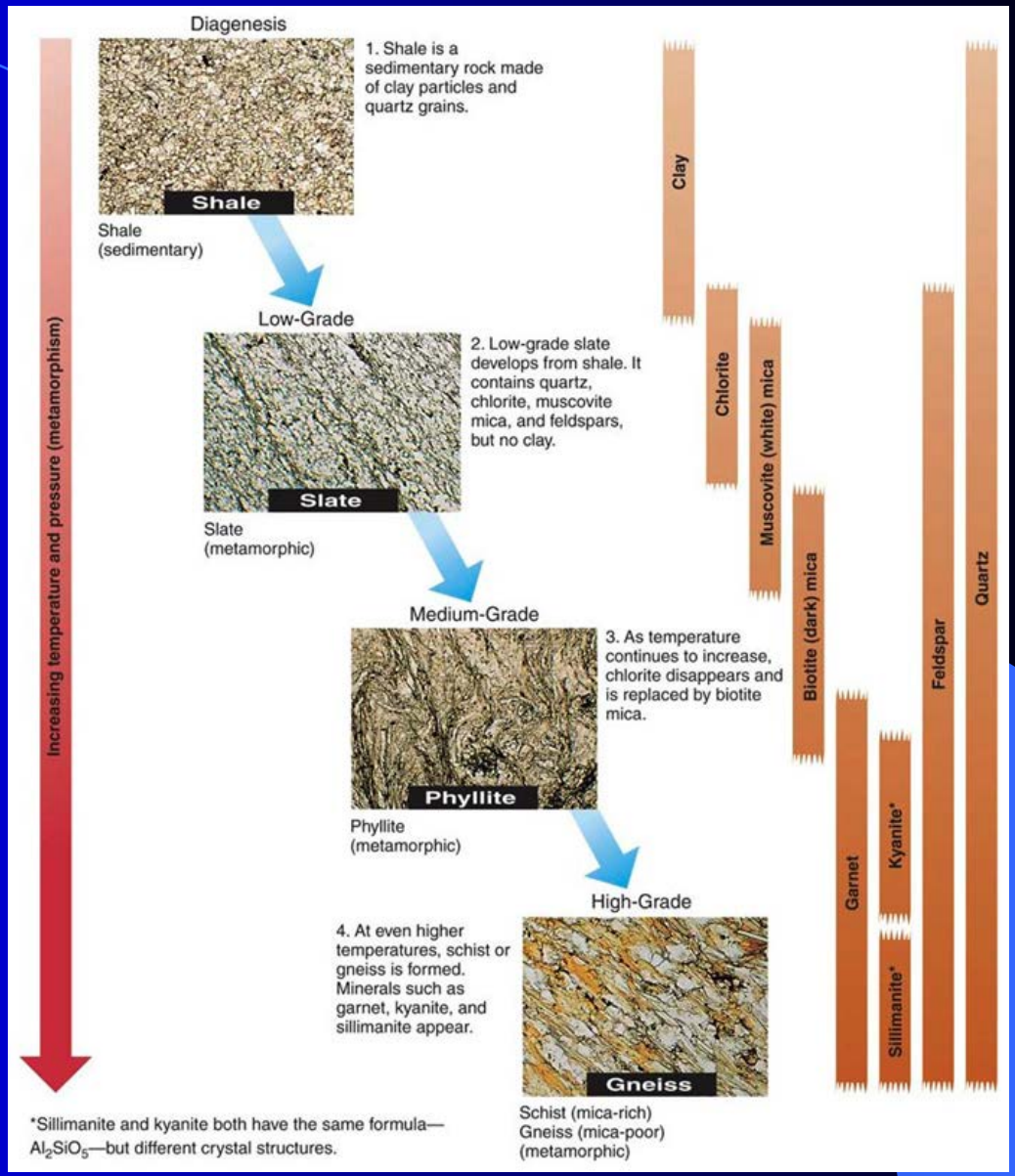


Metasomatic albite + hornblende + tourmaline alteration of metamorphosed granite, Stone Mountain, Atlanta

The term stress implies direction, and is a more useful term than pressure, especially since metamorphic rocks record differential stress in their textures. Differential stress is stress that is not equal in all directions. Commonly this produces the parallel alignment of certain minerals that gives the rock a planar fabric (foliation) or a layered pattern (gneiss).

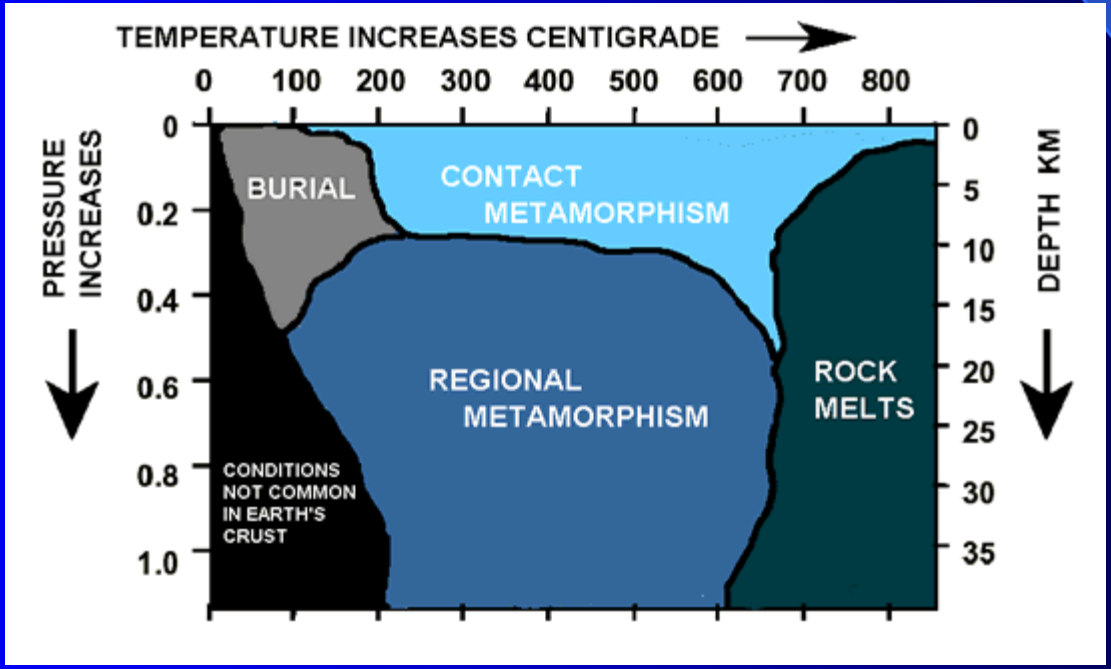


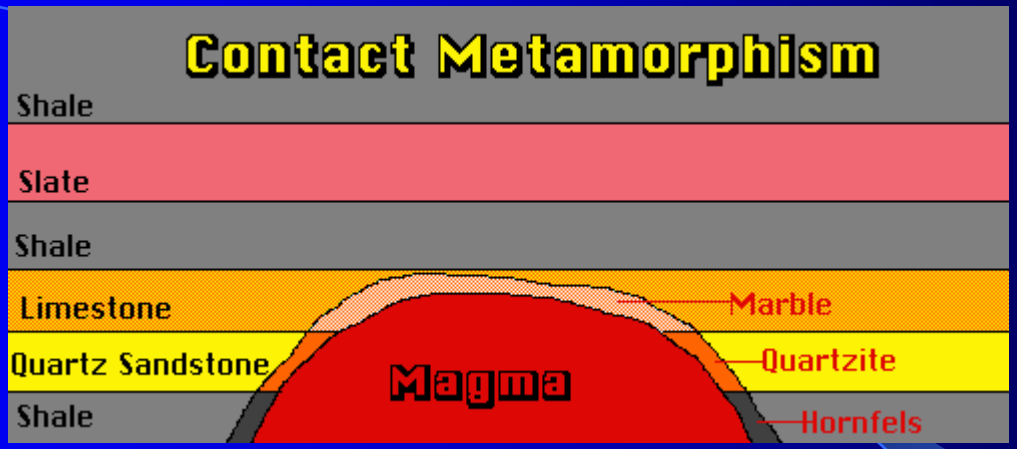
- Rock can be heated by burial, exposure to igneous intrusions, or collision.
- Each of these “heating processes” can be associated with different pressures.
- Metamorphism also produces new mineral assemblages that are stable at the new pressure and temperature.



Changing temperature and pressure lead to either mechanical deformation or chemical recrystallization or both. The different kinds of metamorphism reflect the importance of the two processes

- Contact metamorphism – magma intrudes rock. The high temperatures cause chemical reactions and recrystallization. No directional fabric.
- Burial metamorphism – buried sediments may attain temperatures greater than 150ºC, causing recrystallization. Rocks will develop a foliation.
- Regional metamorphism – extends over a large area. Differential stress, mechanical deformation, and recrystallization.



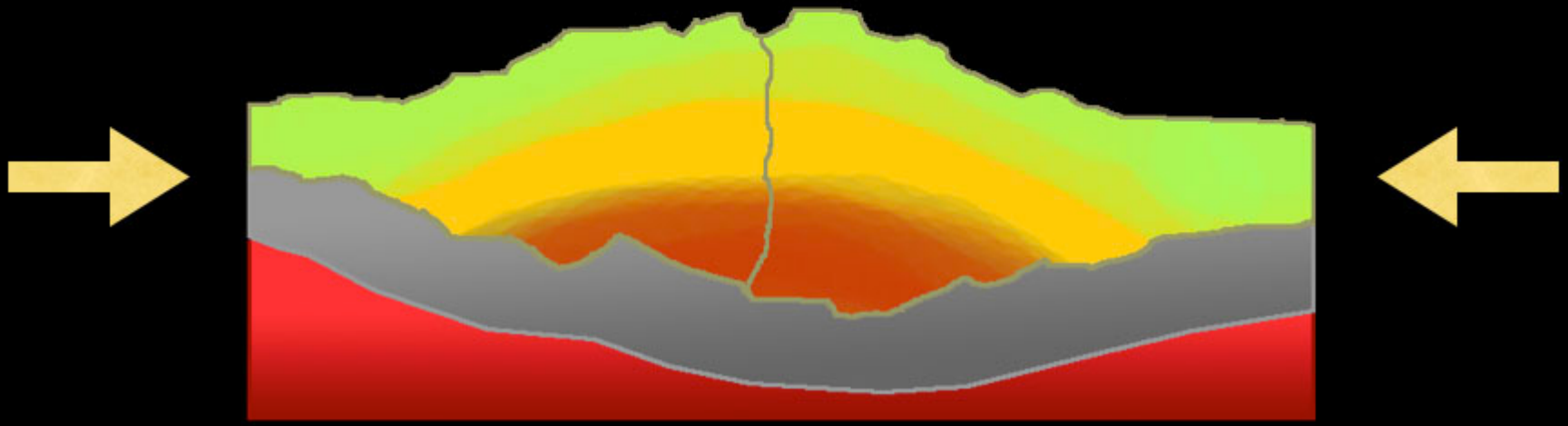


Hornfels

Marble

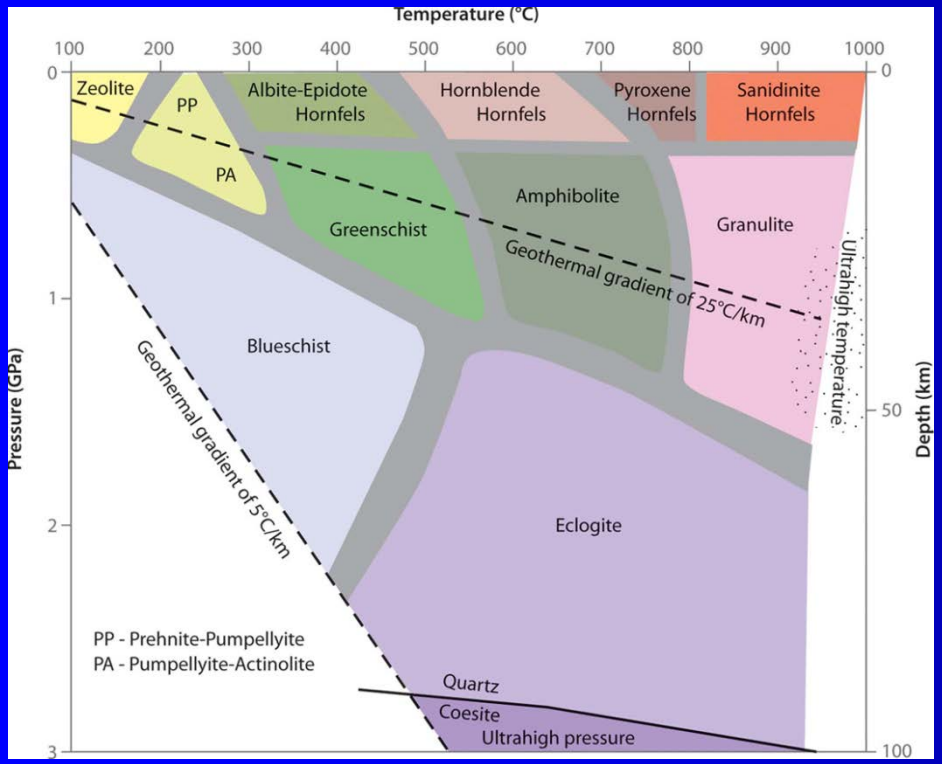
regional metamorphism—a type of metamorphism in which the mineralogy and texture of rocks are changed over a wide area by deep burial and heating associated with the large-scale forces of plate tectonics.

In regional metamorphism, rocks that form closer to the margin of the tectonic plates, where the heat and pressure are greatest, often differ in their minerals and texture from those that form farther away.



continental collision causes regional metamorphism

The concept of metamorphic facies states that for a given range of temperature and pressure and for a given rock composition, the assemblage of minerals formed during metamorphism is always the same



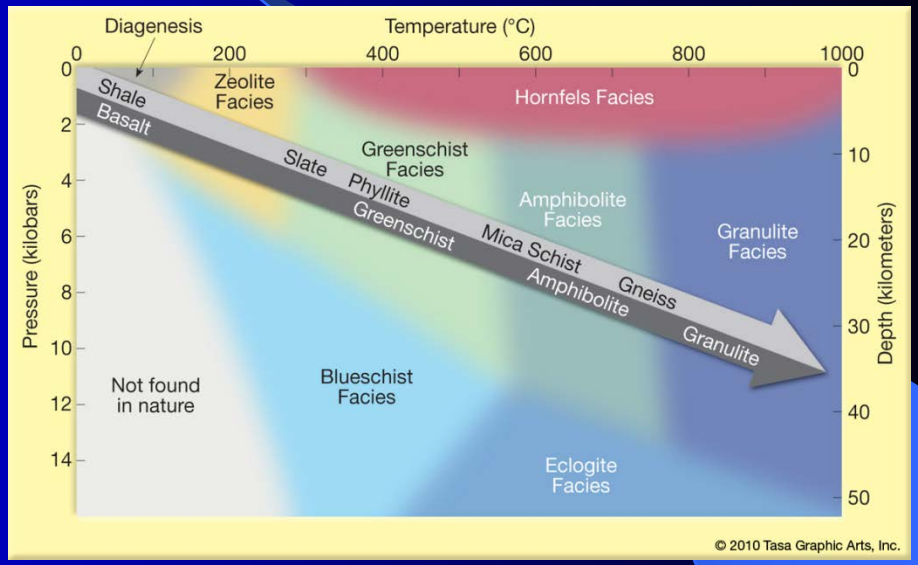


Plate tectonics explains the regional distribution of metamorphic facies and regionally metamorphosed rock