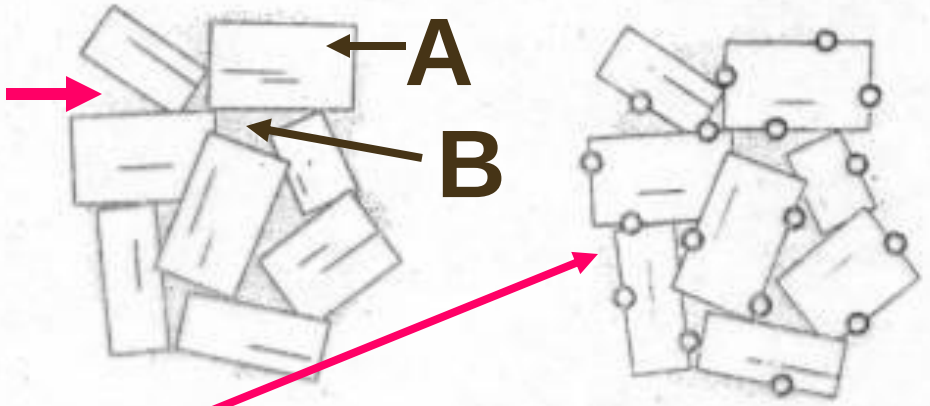
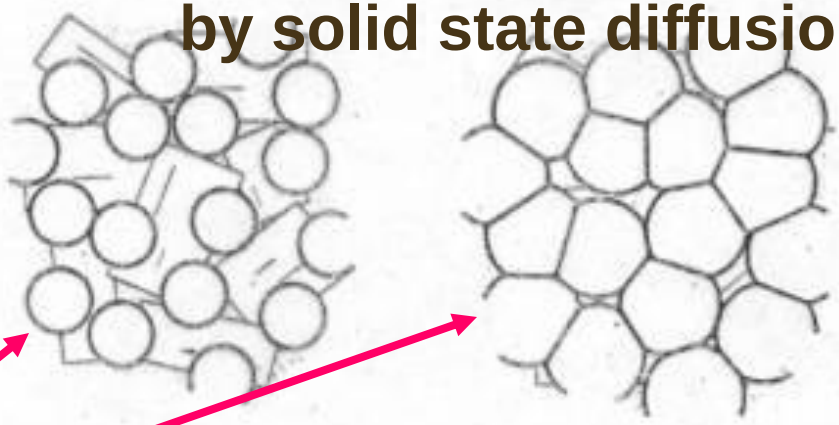
Original Unmetamorphosed rock

Nucleation of new minerals in response to changes in T or P or both

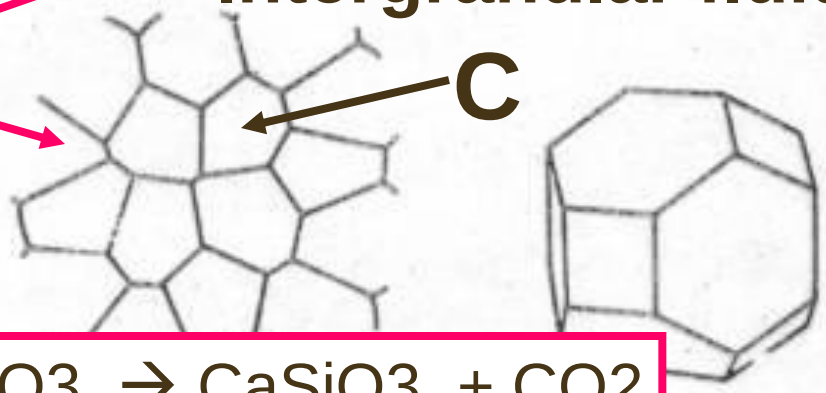
Different stages of mineral growth involve both textural and mineralogical changes



Ions migrate either by solid state diffusion or



Intergranular fluids

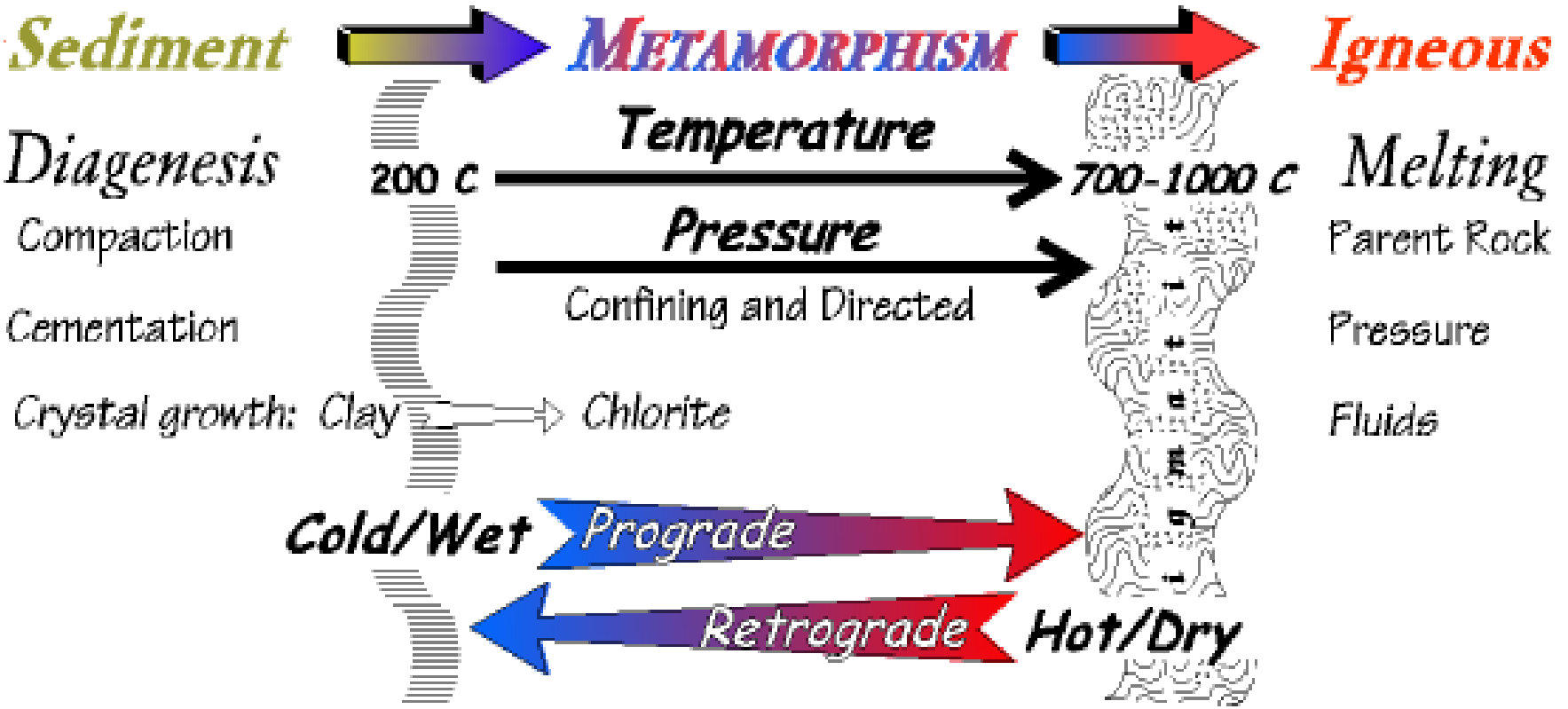


$SiO_2 + CaCO_3 \rightarrow CaSiO_3 + CO_2$

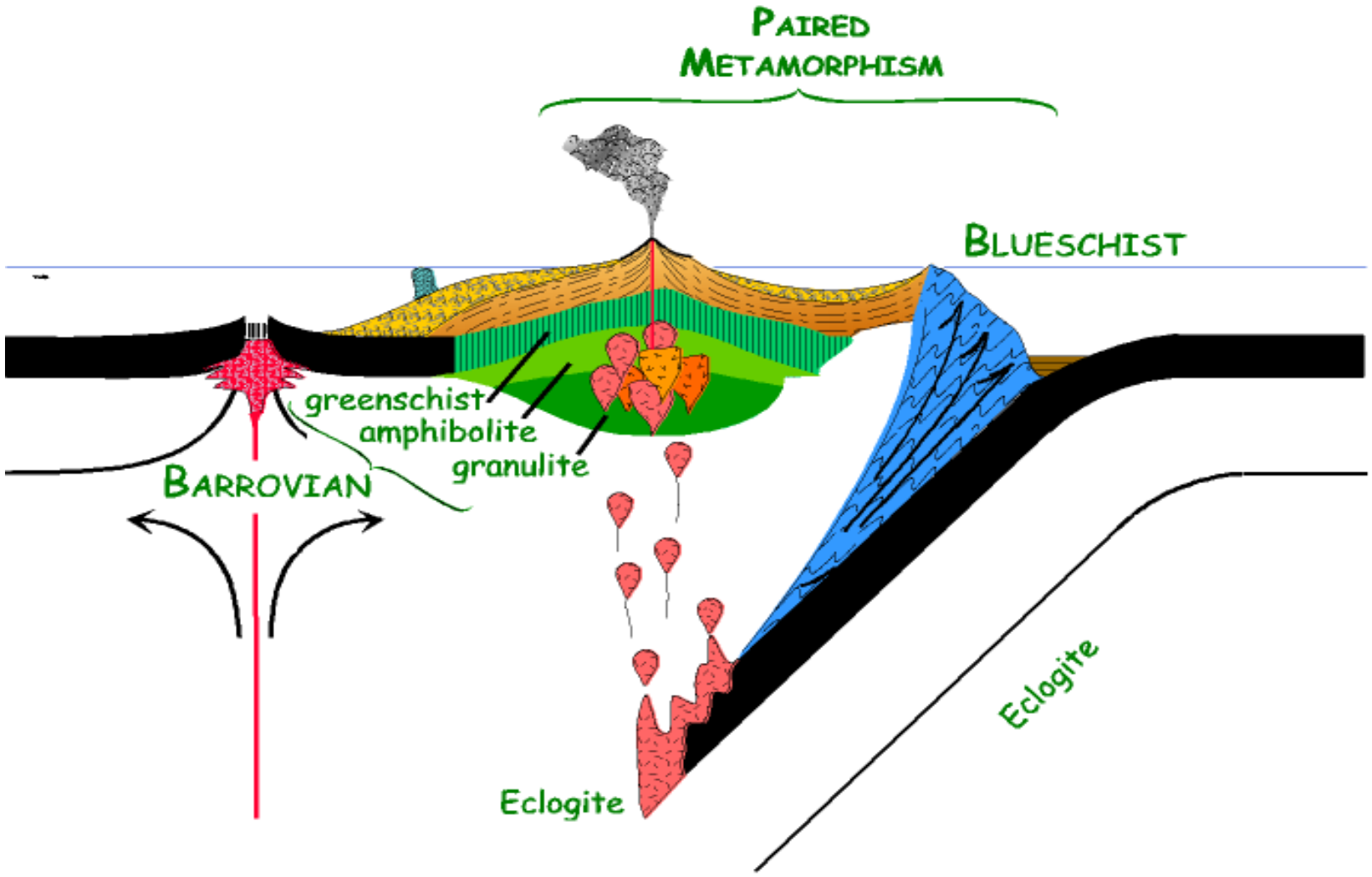
Deformed metamorphic rocks

Types or Envs. of metamorphism

- **Contact** (thermal) metamorphism = around magmas
- **Regional** metamorphism = along subduction zones in areas of mountain building. Rocks in these setting are subjected to both increase in T and to directed pressures.


Sediment
METAMORPHISM
Igneous
Diagenesis
Temperature
200 c
700-1000 c
Melting
Compaction
Pressure
Parent Rock
Confining and Directed
Cementation
Pressure
Crystal growth: Clay
Chlorite
Fluids
Cold/Wet
Prograde
Retrograde
Hot/Dry

Subduction zone and regional metamorphism



Agents of metamorphism

- Heat = thermal energy- geothermal gradient
- Pressure increases at a rate of about 250-300 bars/km of depth.
- Chemical active hot fluids (H2O, CO2 are the most common) moving within the rocks are capable of dissolving rocks and precipitating others at other places

Types of Metamorphism

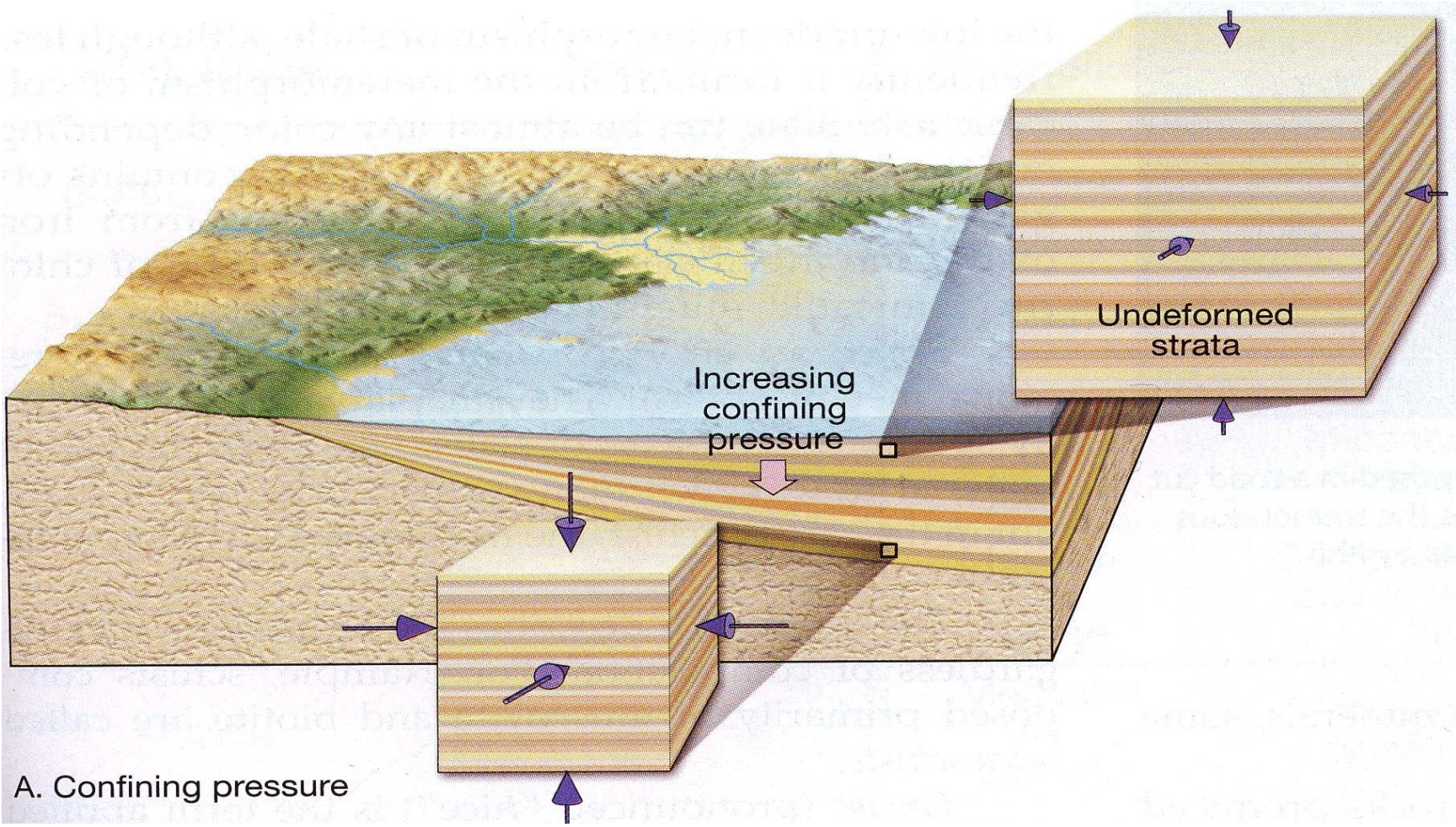
Contact metamorphism

- Heat
- Chemical fluids from an igneous body
- Alter rocks adjacent to the magma

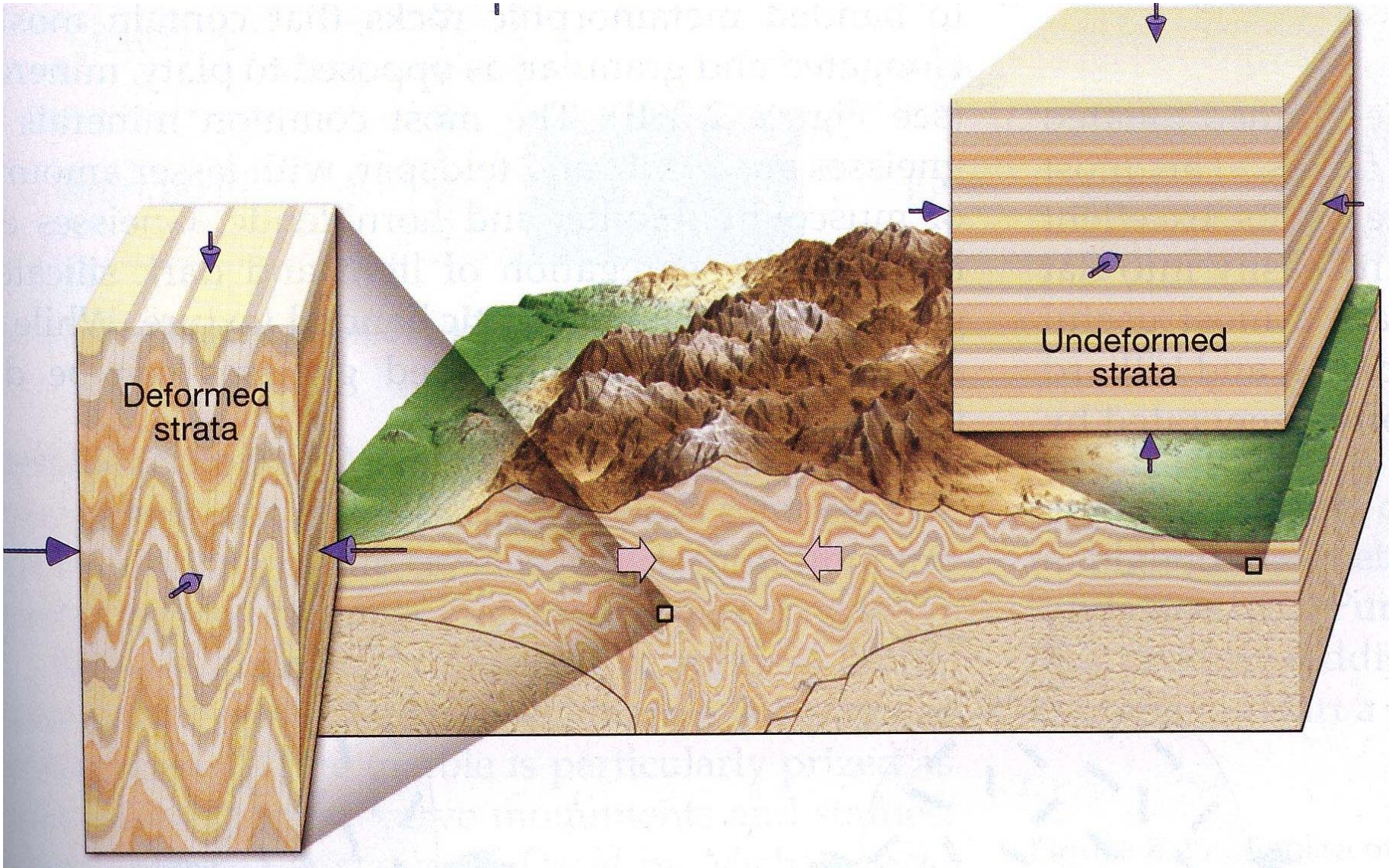
Regional metamorphism

- Large, elongated area
- Tremendous pressure
- Elevated temperatures
- Fluid activity
- Occurs at convergent and divergent plate boundaries

Confining pressure=analogous to hydrostatic pressure

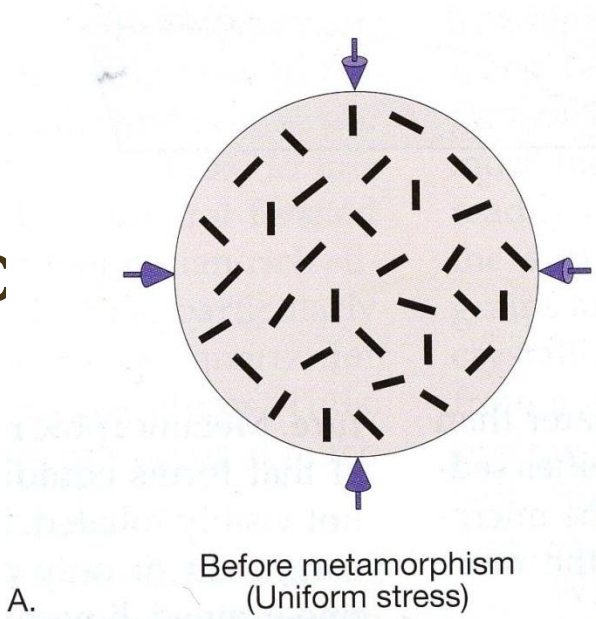


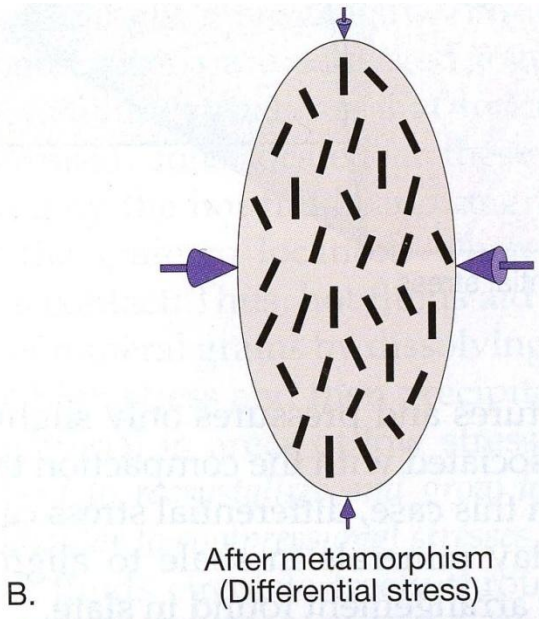
Differential stresses = directed pressures

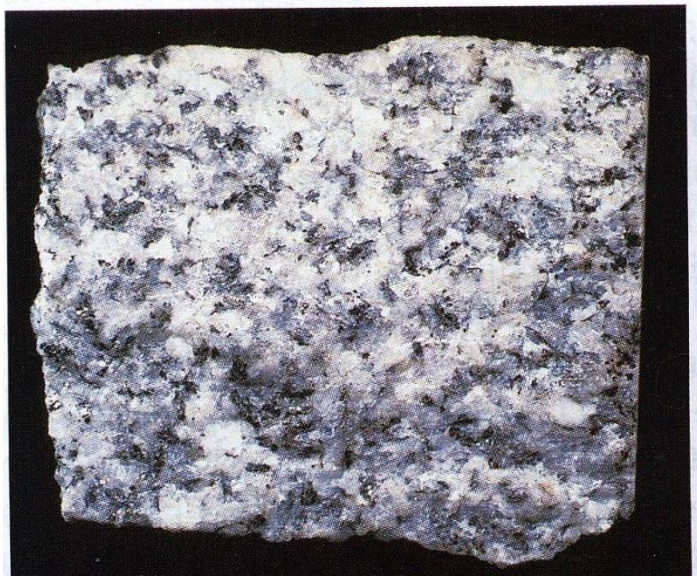


Textures

- Foliated rocks
- = regional
- Metamorphic
- rocks







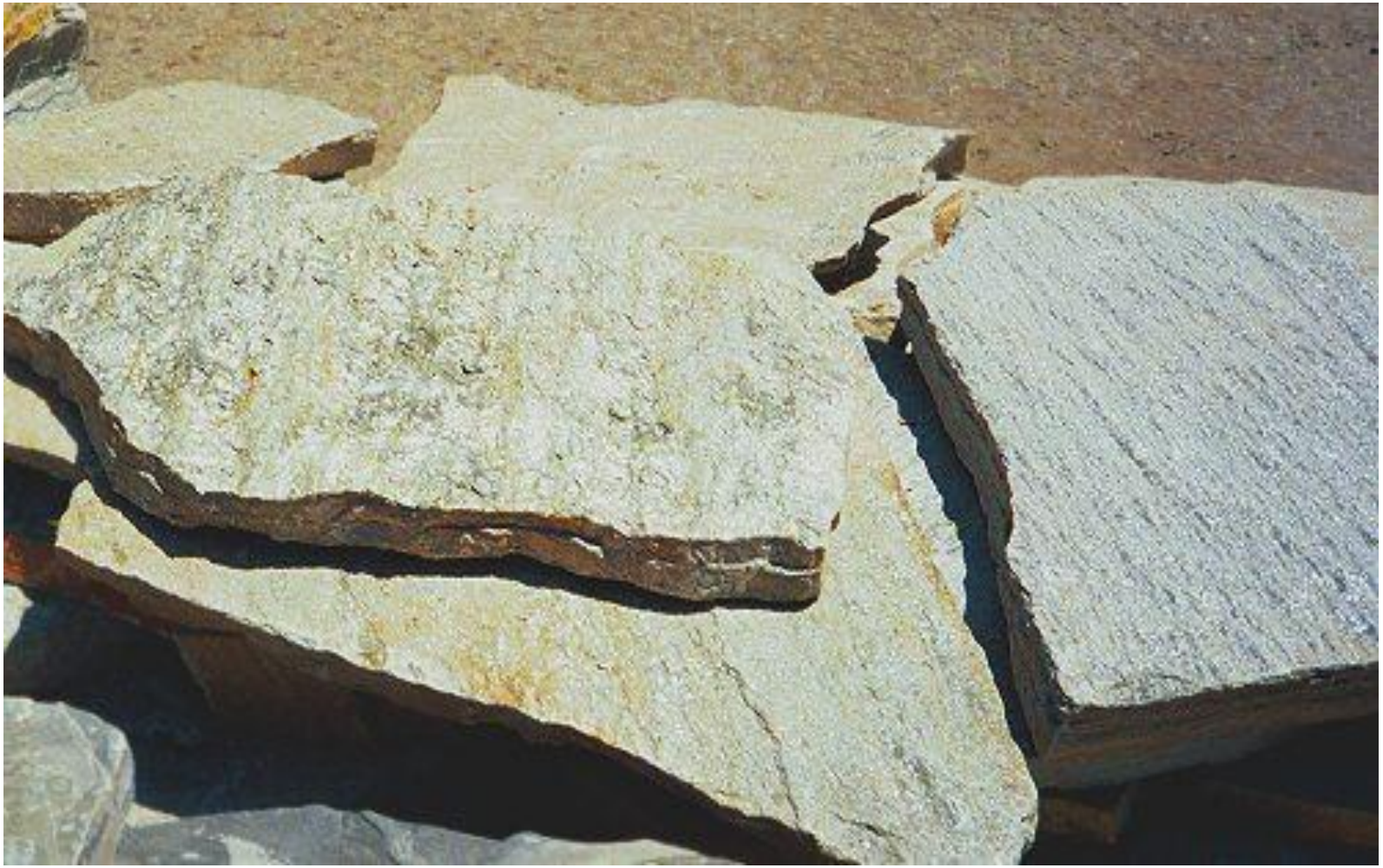
Common metamorphic rocks

Increasing Metamorphism

Rock Name	Texture	Grain Size	Comments	Parent Rock
Slate	Foliated	Very fine	Excellent rock cleavage, smooth dull surfaces	Shale, mudstone, or siltstone
Phyllite	Foliated	Fine	Breaks along wavey surfaces, glossy sheen	Slate
Schist	Foliated	Medium to Coarse	Micaceous minerals dominate, scaly foliation	Phyllite
Gneiss	Foliated	Medium to Coarse	Compositional banding due to segregation of minerals	Schist, granite, or volcanic rocks
Marble	Nonfoliated	Medium to coarse	Interlocking calcite or dolomite grains	Limestone, dolostone
Quartzite	Nonfoliated	Medium to coarse	Fused quartz grains, massive, very hard	Quartz sandstone
Anthracite	Nonfoliated	Fine	Shiny black organic rock that may exhibit conchoidal fracture	Bituminous coal

Slate

Phyllite



http://geology.about.com/library/bl/images/blphyllite.htm

Garnet Schist