Metamorphic Rocks

Definitions

- **Metamorphic Rock**
  - "Meta"= Change *(Grk)*
  - "Morph"= form *(Grk)*
  - a rock that has been changed from its original form (parent) by heat , pressure , and fluid activity into a new rock (daughter).

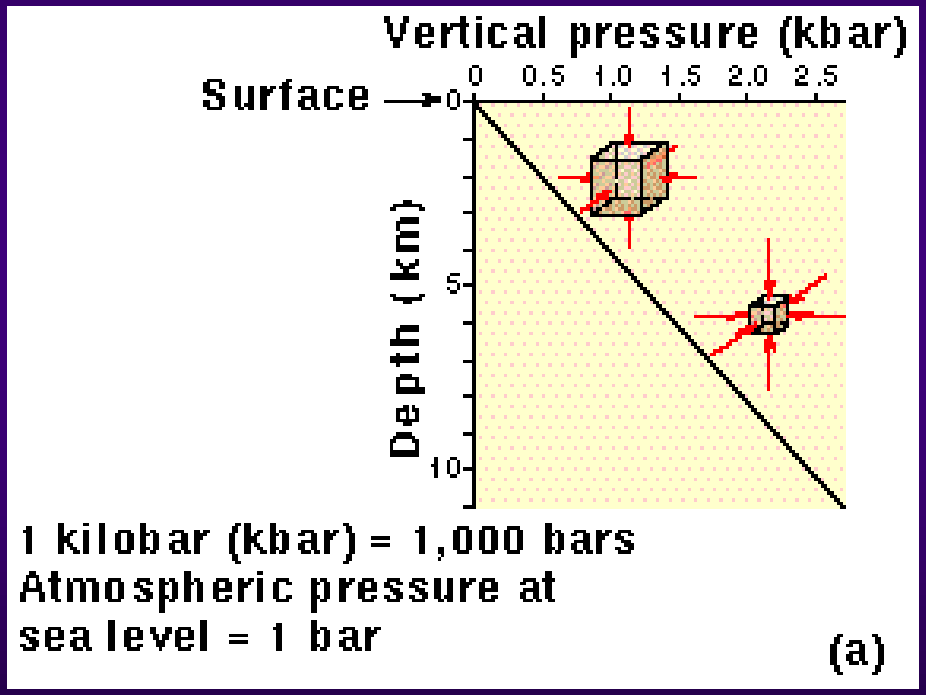
Heat

Sources Include.....

- **Magma**
  - **temperature of magma**
  - **composition of magma**
- **Geothermal gradient**
  - **temperature increases with depth of burial**
  - **core of Earth is warmer than outer crust**

Uniform Pressure vs Directed Pressure

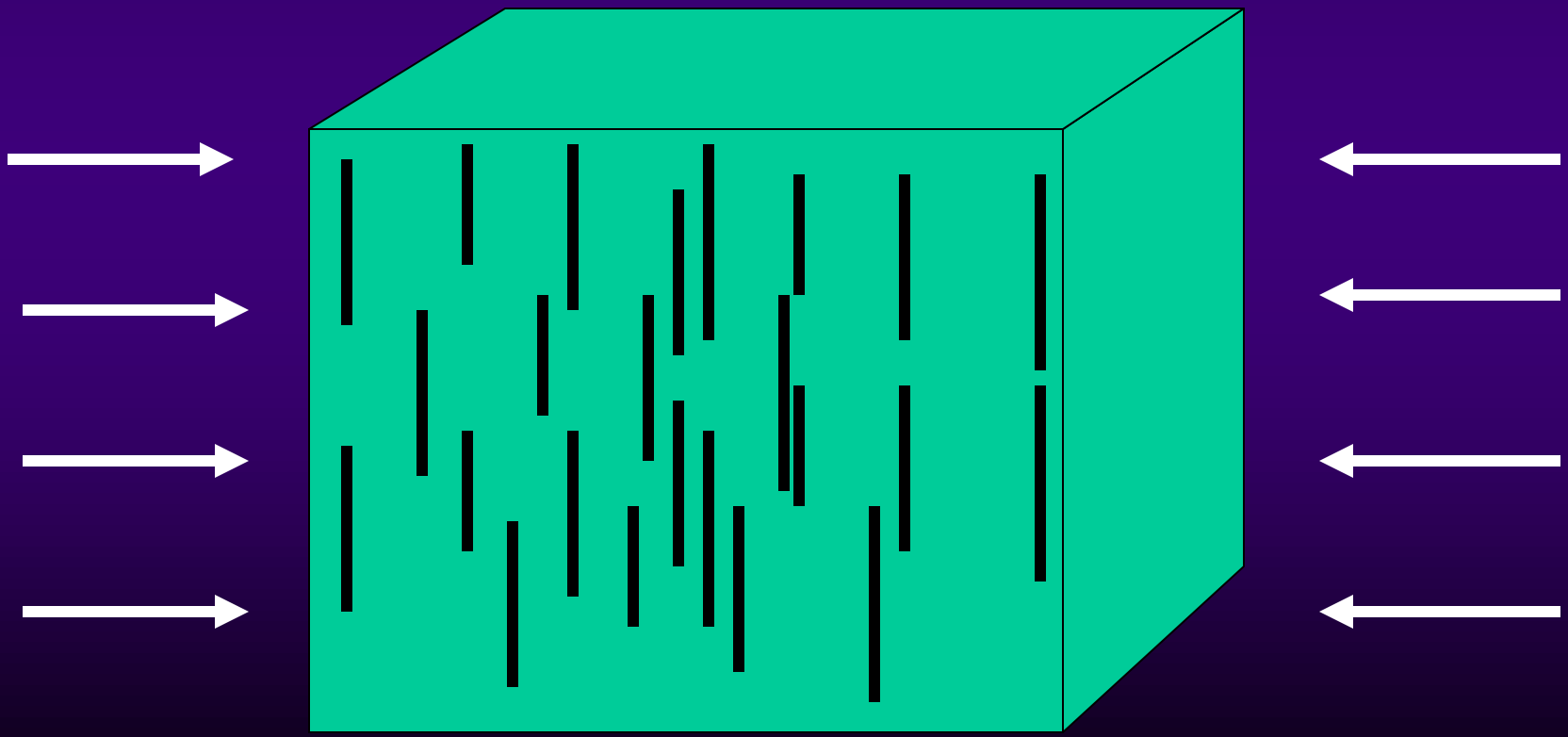
- Lithostatic
  - "Lithos"= rock, static= unchanged (pressure)
  - uniform (aka non-directed)
  - equal intensity from all directions by rocks



Directed Pressure

one direction of squeezing is much stronger than the others

Minerals align themselves to reduce stress.



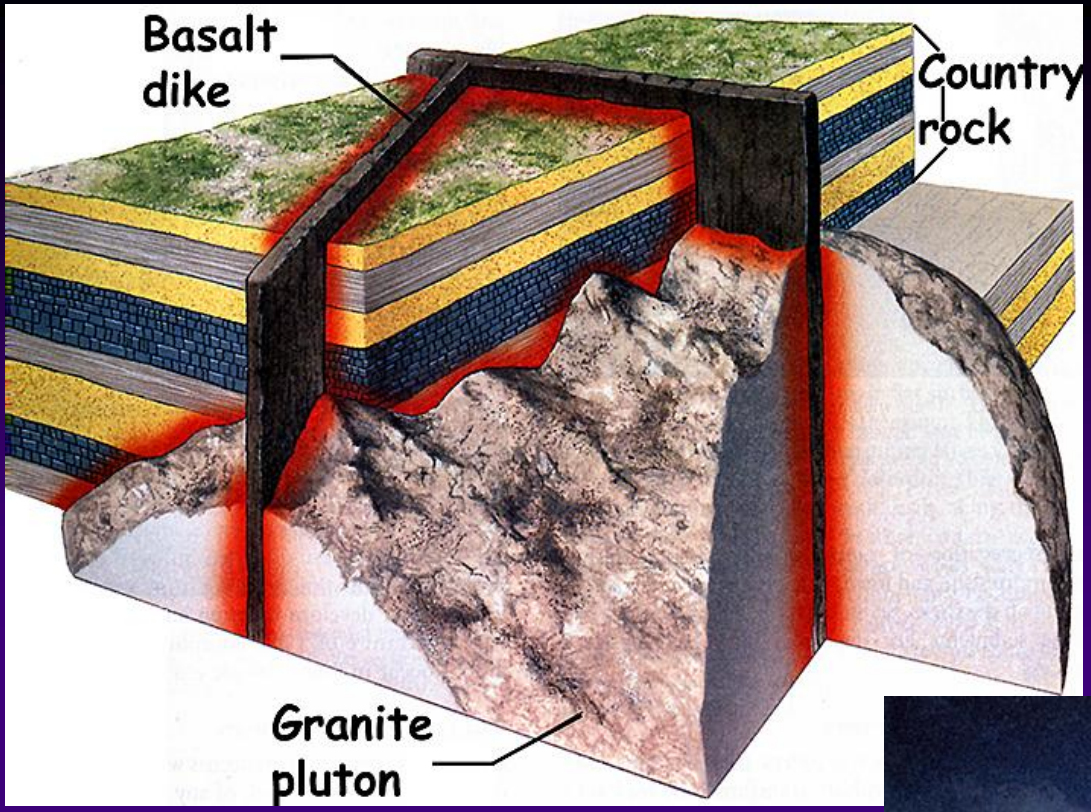
Types of Metamorphism

- Contact
  - caused by igneous activity
- Dynamic
  - aka cataclastic
  - associated with faults & earthquake zones
- Regional
  - caused by tremendous pressures associated with tectonic plate activity

Contact Metamorphism

- **Igneous Intrusions**
  - size and type of magma important
    - mafic magma hotter than felsic
  - heat decreases away from magma
    - forms a zone of altered country rocks called **Aureoles**

Sometimes creates a metamorphic rock called a hornfels -in essence a "cooked" rock


Basalt
dike
Country
rock
Granite
pluton

Dynamic Metamorphism

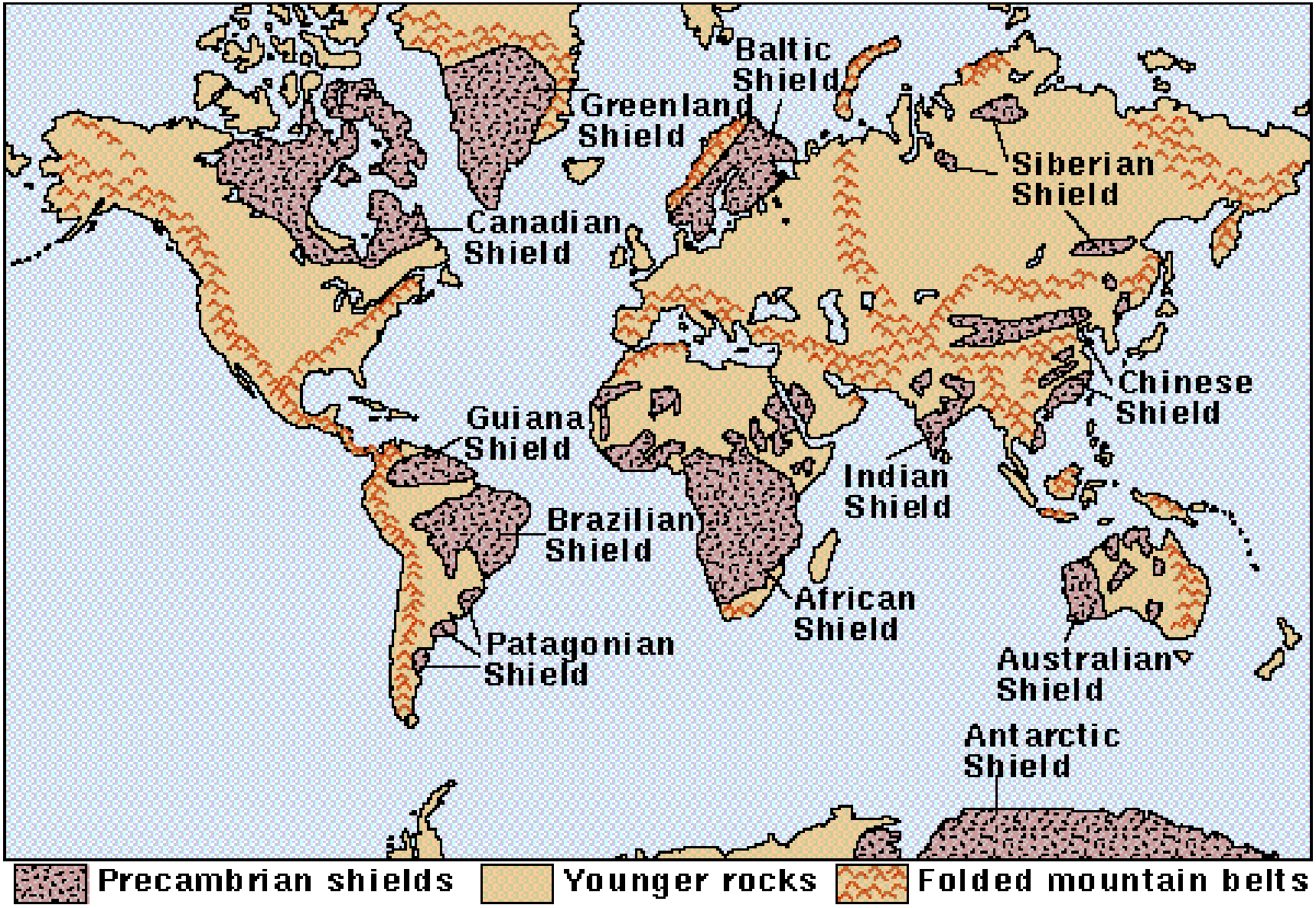
- *aka Cataclastic* Metamorphism
- associated with Fault Zones
  - Places where the Earth's crust ruptured
  - Rock pulverized
    - > heat and pressure come from movement along the Fault
- resultant rock is known as a *Mylonite*

Regional Metamorphism

- Most common form of metamorphism
- caused by large scale forces
  - lithospheric plate collision
- covers very large areas
  - metamorphic belts or zones
  - Zones are characterized by *Index Minerals*
    - form under specific temperatures and pressures
    - metamorphic facies
- commonly associated with
  - shields: stable areas of crystalline rocks

Shields and Mountains: areas of crystalline rocks

Shields of the World

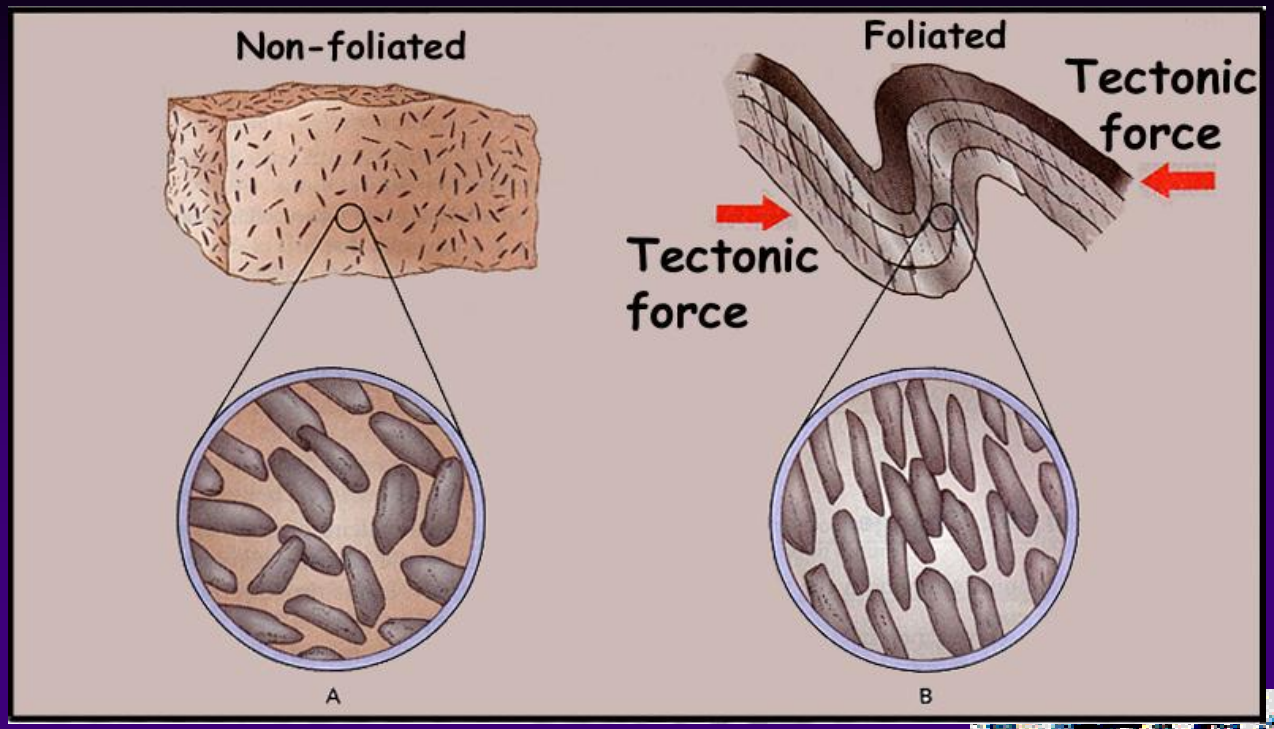


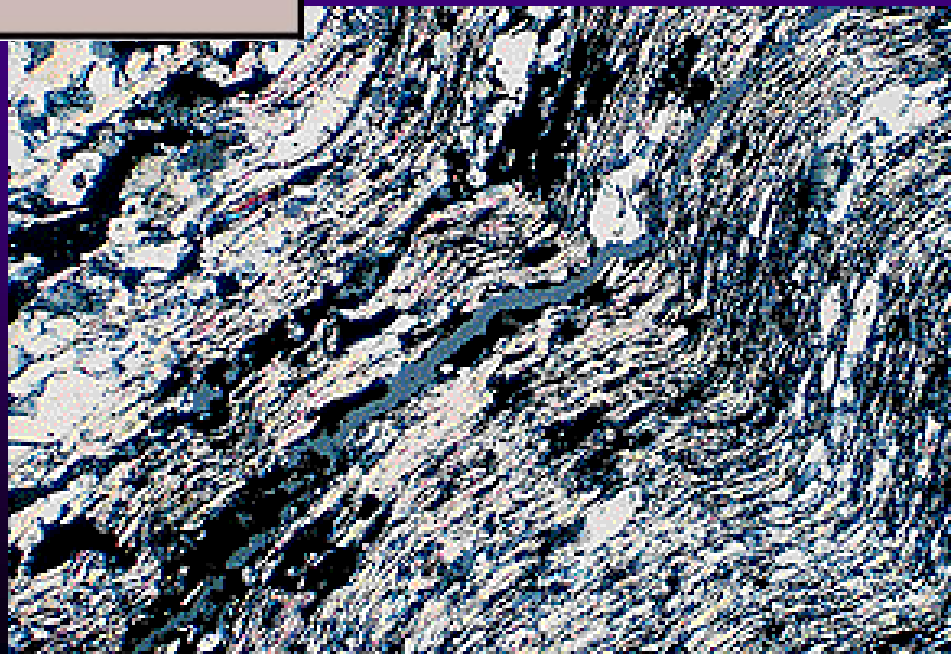
Metamorphic Textures

- **Foliated**
  - Folios = page or leaf-like
  - rock has distinct banding or layering
    - > often not smooth like in sedimentary rocks
  - formed under directed pressure

- **Non-foliated**
  - no distinct layering character
  - often a massive crystalline texture
  - formed under uniform pressures

Foliated Texture





Foliated Textures

- **Slatey**
  - looks like blackboard
    - > dull surface
  - smooth, thin layering
  - breaks into flat slabs
    - > referred to as slatey cleavage
  - no mineral grains visible

- **Phyllitic**
  - looks like waxed surface
    - > has a "sheen" to it
  - may have little "waves" on surface
    - > referred to as *crenulations*
  - some small grains visible

- **Schistose**
  - distinct bands of minerals
  - visible mineral grains
    - > garnets, staurolites
  - may have shiny appearance
    - > due to mica minerals

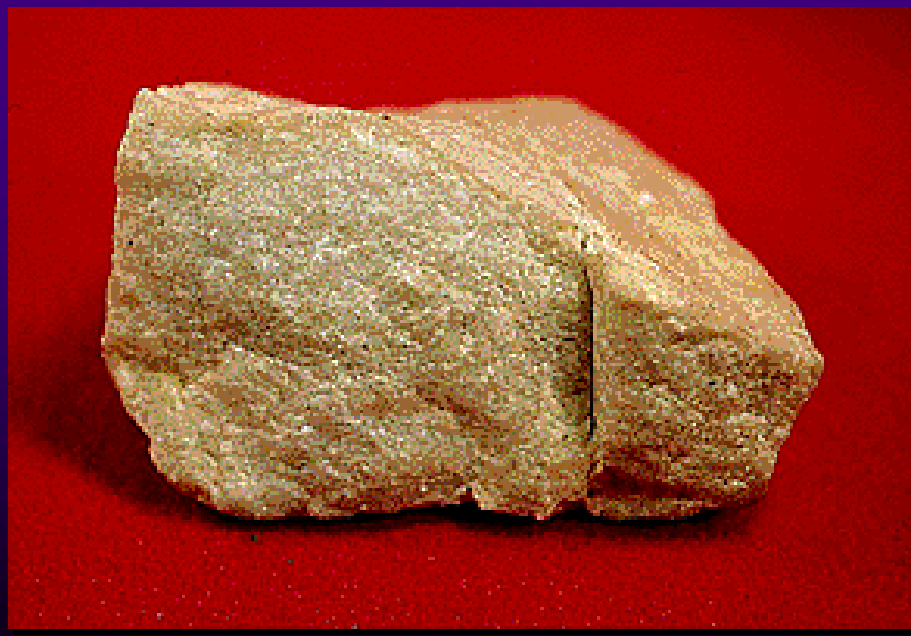
- **Gneissic**
  - larger grains
  - may look like igneous rock
  - may have crude banding
    - > intensely distorted
  - different minerals than schistose

Foliated MM Rocks

MM Rocks that could form as a shale (sedimentary) parent rock is exposed to increasing directed pressure and temperature

Non-foliated Rocks

- **Marble:**
  - metamorphosed limestone



- **Quartzite:**
  - metamorphosed quartz sandstone

Environment of Formation- EOF

look for specific minerals

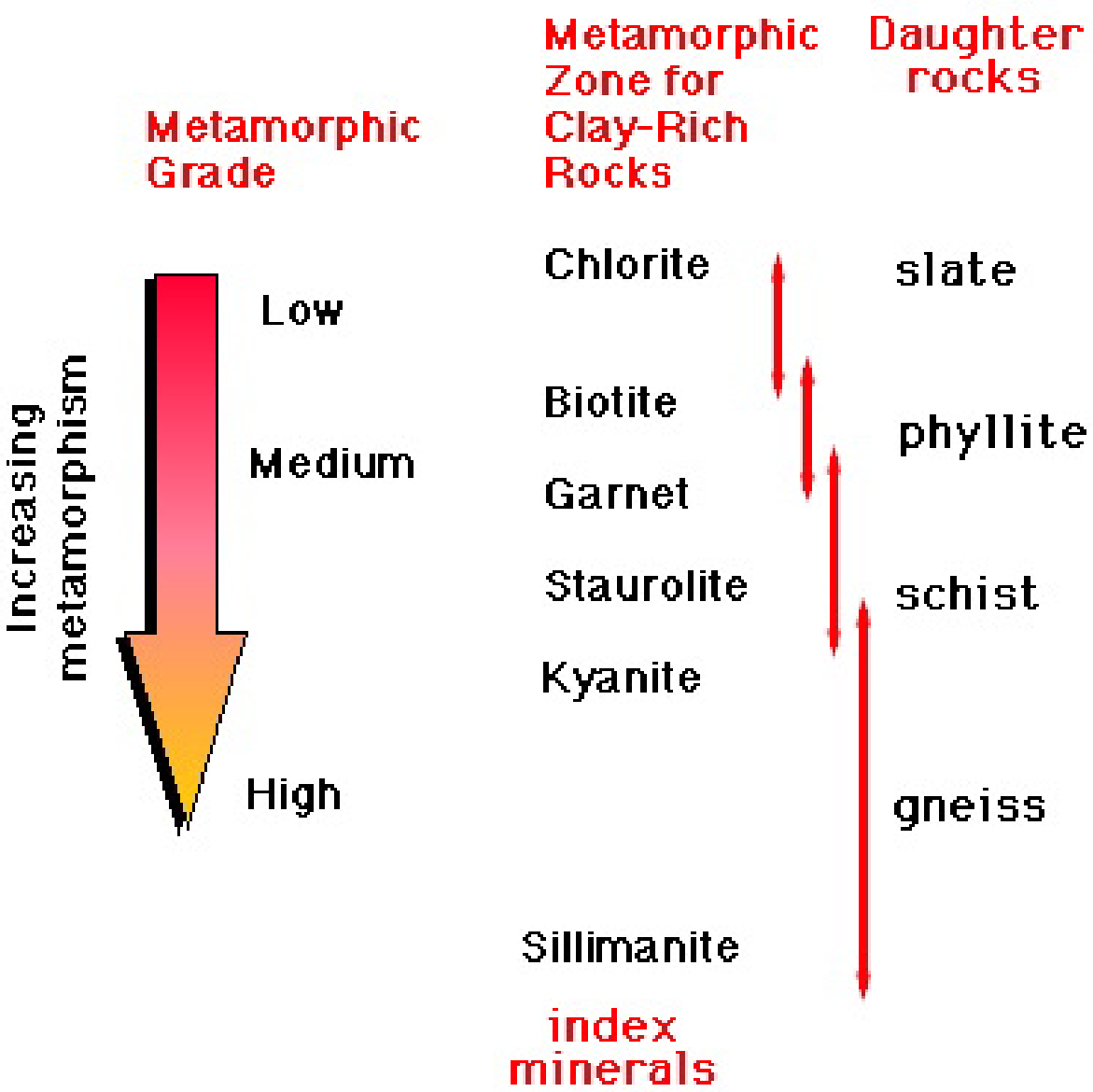
Map out where those minerals are found

reconstruct T & P for given minerals

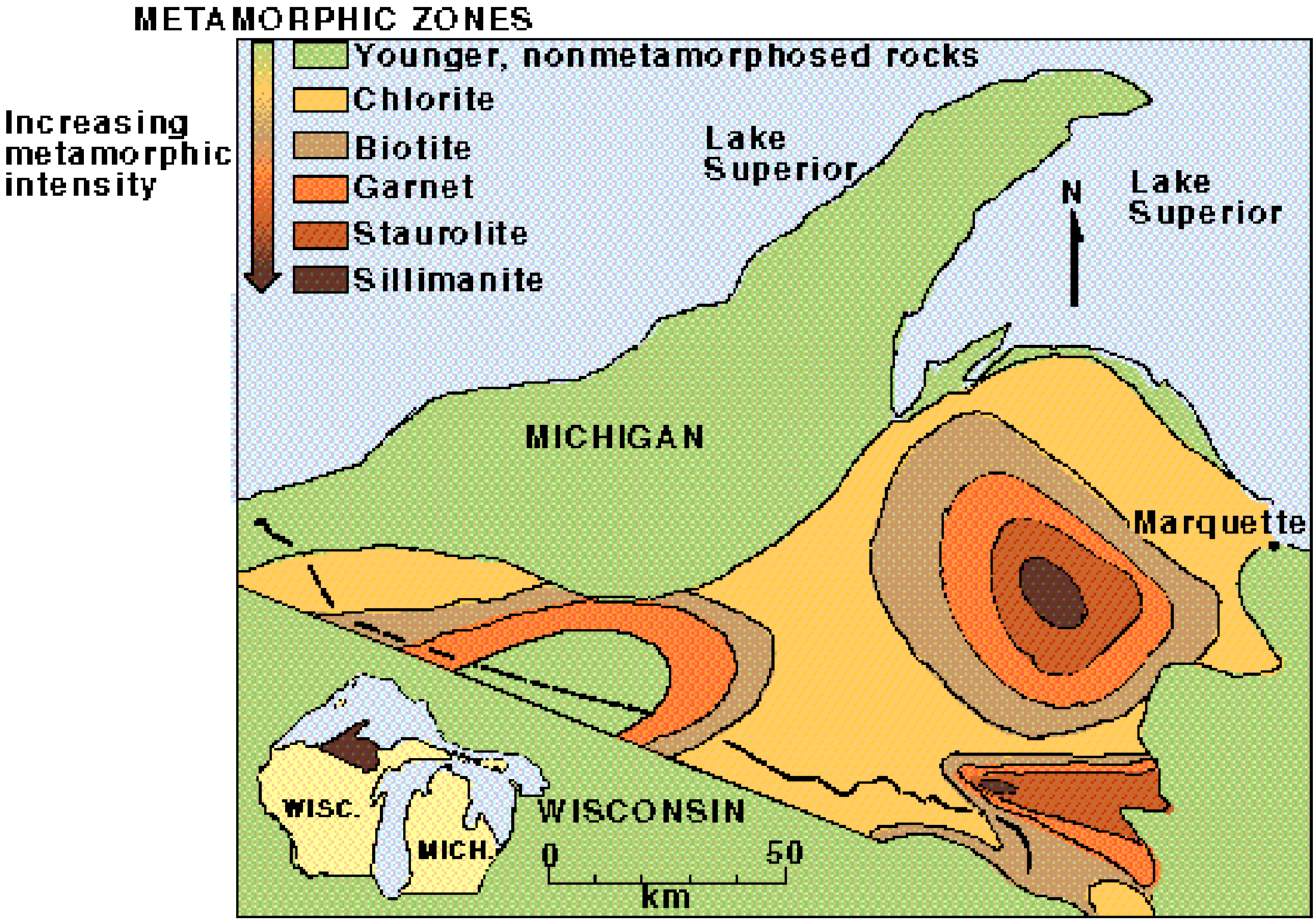
Find a modern setting that has similar T & P

using *Uniformitarianism*

Metamorphic Zones

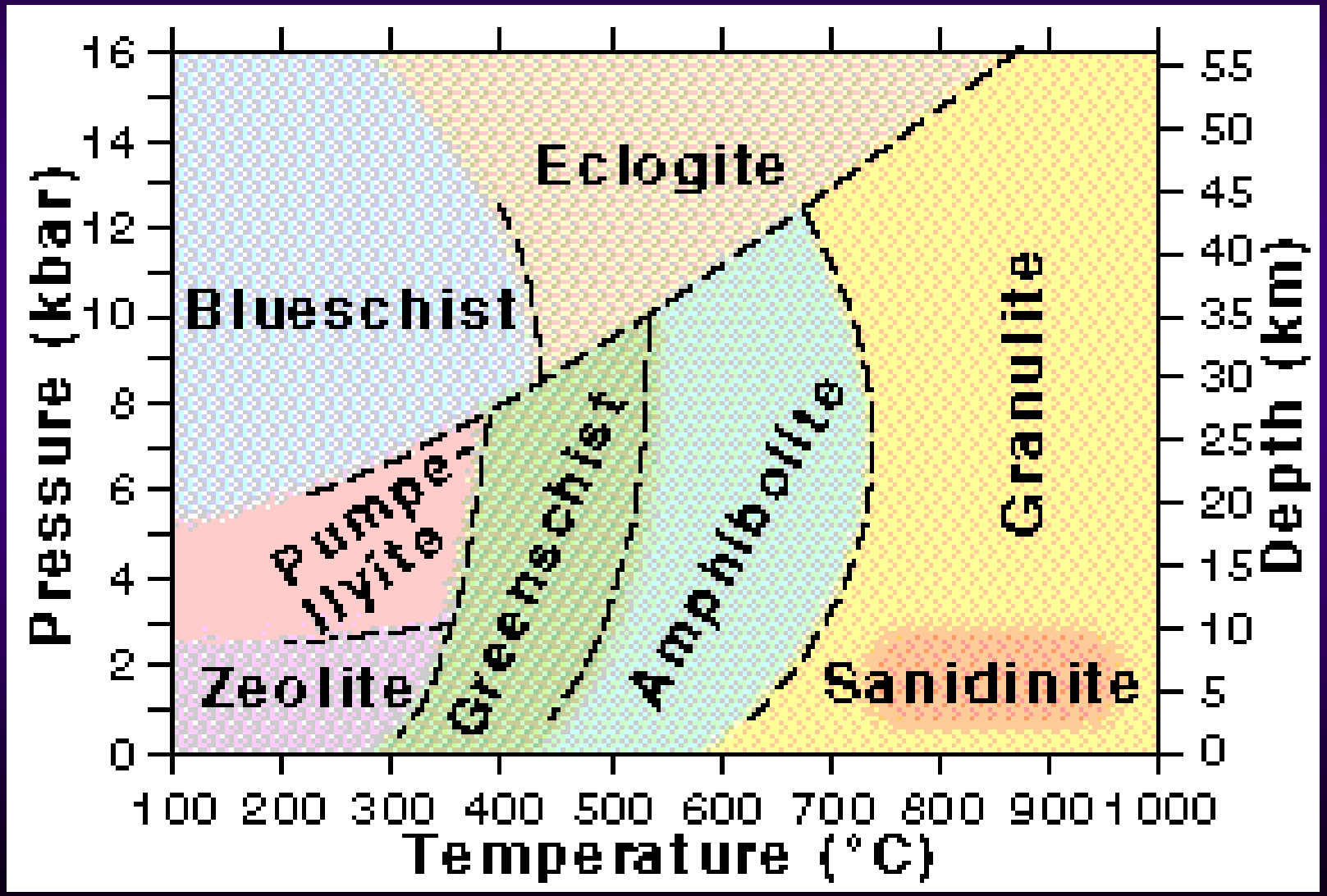


Metamorphic Zones-Map



Metamorphic Facies

- distinctive metamorphic lithologies that occur in well defined areas and named after the key rocks found



Metamorphic Zones

- Metamorphism is common along most plate boundaries like this.