

February 5, 2015
GEOL 1010-002 (Notes)

Lecture 6 - Metamorphism & Structural Geology

Geology in the News

- Fossils survive volcanic eruption, help explain the formation of Canary Islands (unusual → fossils don't usually survive eruptions)

Intro to Metamorphism

- Find exotic and neat mineral types (Why we care)
- Understand history of diff. areas
 - ① Ex. How Mt. Ranges Form
 - ② Ex. Pilate Mts (Unusual → Alone, not in a Mt Belt)
- Slow Process - Million year time scale to form metamorphic rock

Temperature

- * Geothermal gradient → How fast does temp go up with depth
- Avg: $30^{\circ}\text{C}/\text{km}$ (G.G. on Earth)
- Typical Range: $20-60^{\circ}\text{C}/\text{km}$
- Increase temp/pressure ^{High G.G.} to form new rock (below surface of Earth)
 - ① Cook, NOT melt rock (In order to change into metamorphic rock)

Metamorphism via Heat

- Contact Metamorphism - When making rock, temp is the main variable
 - ① Magma (below surface) flows into a new area and heats rocks up (to form metamorphic rock)
 - ② Pressure increases slightly
 - ③ C. M. pretty localized in its scope (layers further away not experiencing change really) or heat
 - ④ Smaller Scale

Pressure

- Pascals and bars (metric unit - base 10)
 - ① 1 bar = atmospheric press @ Earth's surface
- Pressure gradient: -300 bar/km depth (below surface - average)
 - ① Pressure increases with depth below surface
- Confining Pressure - rock squeezed evenly from all directions
 - ① Ex: Swimming under water
- Directed Pressure (AKA Differential) - one primary direction of pressure (one side)
- Pressure important because tells what type of metamorphic rock will form + type of minerals in rock

How Much Pressure Is Needed?

- Forms in deeper part of crust
- Most metamorphic rocks form at 10-30 km depth (mid-lower crust)
 - ① Q: How many miles is that?
 - ② A: Roughly 6.25 mi - 18.75 mi

Exposure

- How do metamorphic rocks get back to the surface?
 - ① Move body of rocks due to faults forming (shifting relative to surface)

Metamorphism via Pressure

- Regional Metamorphism - Pressure main variable
 - ① Large Scale (opposite of contact metamorphism)
 - ② Lot of pressure increase due to convergent boundaries
 - ① How - Subduction Zones

Other Metamorphic Types

- Fault Metamorphism - Lot of pressure needed so rocks can form via faults
 - ① Causes lots of damage as rocks slide by (crushed, damaged, distorted)
 - ② Common in SC

→ When the water is very hot with the right mixture of chemicals, it can actually dissolve the rock, and some materials precipitate out of the water that fill the void → Pushing out old material, and putting new materials in its place

Metamorphism via Fluid (On Exam)

• Metasomatism - small scale → exposing rock to very hot fluids like hot ground water. The water flows through rocks and can induce metamorphic change.

① New minerals left behind contain ore deposits (something valuable in high concentration)

Weird Temp Gradient →

• Seafloor Metamorphism - very large scale → Same hot fluid ground water can circulate within the rock and exit out of small places

① Alters newly formed rocks (Bright vivid green rock) on the seafloor box (gives it a different appearance)

Metamorphic Rocks & Environments

*Rock form at end has something to do with rock started off with

• Q: What M.R. forms?

• A: Parent rock's composition is key

① Shale → Slate
Parent Rock

Metamorphic Change

Not Very Helpful →

• Grade - How much change occurred (How much did you increase T/P?)

① Diagenesis - Not metamorphic (shallow - like a burial) → rock doesn't undergo metamorphism

More Helpful →

• Index Minerals - forms at a very narrow (specific) range of temp and pressure

① Red Names (In PowerPoint) - Index Minerals

• Facies - a group of minerals that represent a certain property/environment they form in (properties)

7 Major Metamorphic Facies

• Specific conditions in which the minerals forms in

• Look at highest possible value (Temp/Pressure) on chart