Last Time

Contact Metamorphism
A) Metamorphic Aureoles
B) Isograds
C) Index minerals and metamorphic grade
Contact Metamorphism

- Heat only
- Induced by hot intrusions
- Metamorphic aureoles

http://academic.brooklyn.cuny.edu/geology/grocha/monument/images/metheat.gif
Contact Metamorphism

- Metamorphic grade decreases from the intrusion into the country rock
Contact Metamorphism

Contact metamorphism is commonly very obvious in outcrop.
Contact Metamorphism

- Marble
- Hornfels
- Sill
- Shale
- Limestone

http://z.about.com/d/geology/1/0/A/z/contactmet500.jpg
Contact Metamorphism

Metamorphic Isograds
Isograds around the Kangmar Dome of Tibet

Contact Metamorphism

Isograds

http://www.geol.ucsb.edu/faculty/hacker/geo102C/lectures/KangmarIsograds.jpg
Isograds

Isograds in Scotland

Regional Metamorphism
Index Minerals (Felsic rocks)
Index Minerals (Mafic rocks)

Important observation: Amphibole only forms from parent rocks rich in Fe and Mg. Therefore the parent rock of most amphibolites is basalt.
Today’s Agenda

Last bit about Metamorphism

A) Metamorphic Facies
B) Retrograde Metamorphism
C) Shock Metamorphism

Web notes 25A: Metamorphic Facies
Web notes 25B: Retrograde Metamorphism
Metamorphic Facies
Metamorphic Facies

The Problem:

Parent rock  →  High Grade Metamorphic rock

Shale

Rhyolite  →  (granite) Gneiss

Granite
Metamorphic Facies

The Problem:
Parent rock $\rightarrow$ High Grade Metamorphic rock

Shale
Rhyolite $\rightarrow$ (granite) Gneiss
Granite

The Solution:
Consider conditions of pressure and temperature rather than parent rock composition
Metamorphic Facies

Temperature

Pressure

Lowest Grade

Highest Grade

Partial melting
Metamorphic Facies

Partial melting

Zeolite facies
Metamorphic Facies

Temperature

Low  High

Pressure

High

Zeolite facies

Hornfels facies

Partial melting
Metamorphic Facies

Zeolite facies

Hornfels facies

Blue schist

Temperature

Pressure

Partial melting
Metamorphic Facies

Temperature

Low High

Pressure

Low High

Zeolite facies

Hornfels facies

Greenschist

Blue schist

Partial melting
Metamorphic Facies

Zeolite facies
Greenschist
Amphibolite
Hornfels facies

Temperature
Pressure
Low
High
Partial melting
Metamorphic Facies

- **Temperature**
- **Pressure**

- Zeolite facies
- Hornfels facies
- Greenschist
- Blue schist
- Amphibolite
- Granulite

Partial melting
Metamorphic Facies

Temperature

Zeolite facies
Greenschist
Amphibolite
Granulite
Eclogite facies
Hornfels facies

Pressure

Low
High

Partial melting
Metamorphic Facies

Temperature

Low High

Pressure

High

Burial curve (prograde metamorphism)

Partial melting
Metamorphic Facies

Pressure

Low

Zeolite facies

slate

phyllite

Partial melting

Temperature

High

Greenschist

Amphibolite

Granulite

gneiss

Eclogite facies
Metamorphic Facies

Temperature

Pressure

Low

High

Partial melting

Burial curve

(contact metamorphism)

(Regional metamorphism subduction)
Metamorphic Facies

Temperature

Low
High

Pressure

Retrograde metamorphism

Burial curve (prograde metamorphism)

Partial melting
One More Type of Metamorphism

- Shock metamorphism: caused by high energy impacts (e.g., asteroids)

[Diagram showing temperature and pressure conditions for shock metamorphism]

http://www4.nau.edu/meteorite/Meteorite/Images/ShockMetamorphism.jpg
Today’s Homework

1. Start Studying for finals (word list 3 is up)
2. Rock/mineral assignment due Friday by 5:00 PM

Next Time

1. Structural geology part 1

GY 302 Poster Session. Tuesday Nov 22 12:00-2:00PM (Bonus)
Rock and Gem Show Thanksgiving weekend (Bonus)
proof of attendance required for both bonuses
GY 111: Physical Geology

Lecture 25: Metamorphic Facies

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