

## Minerals of Metamorphosed Mafic Rocks

Mafic rocks generally have igneous protoliths: basalt or its coarse-grained equivalent, gabbro

### Minerals of Metamorphosed Mafic Rocks

Plagioclase  $(\text{Ca,Na})(\text{Al,Si})_4\text{O}_8$

- (like in igneous rocks)

### Amphiboles (double-chain silicates)

Common properties of all amphiboles?

- Tremolite-Actinolite
- $\text{Ca}_2(\text{Mg,Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$
- light to dark green, colorless in thin section
- 
- Hornblende (complex formula related to tremolite-actinolite)
- dark green to black, green or brown in thin section
- 
- Glaucophane (blue sodic amphibole)

- $\text{Na}_2\text{Mg}_3\text{Al}_2(\text{Si}_8\text{O}_{22})(\text{OH})_2$

Actinolite

Hornblende in thin section

Glaucophane (blue amphibole)

More Minerals of Metamorphosed Mafic Rocks

- Pyroxenes (similar to those in igneous rocks)
- Clinopyroxene (diopside)  $\text{Ca}(\text{Mg,Fe})\text{Si}_2\text{O}_6$

light to dark green

inclined extinction (in microscope)

moderate birefringence

- Orthopyroxene (enstatite)

$(\text{Mg,Fe})_2\text{Si}_2\text{O}_6$ , or  $(\text{Mg,Fe})\text{SiO}_3$

tan to brown

parallel extinction (in microscope)

low birefringence

More Minerals of Metamorphosed Mafic Rocks

- Epidote (paired tetrahedra and isolated tetrahedra in a silicate)

- $\text{Ca}_2(\text{Al,Fe}^{3+})\text{Al}_2\text{O}(\text{SiO}_4)(\text{Si}_2\text{O}_7)(\text{OH})$
- **pistachio green** color is characteristic
- 
- Chlorite (dark green sheet silicate)
- $(\text{Mg,Fe,Al})_6(\text{Si,Al})_4\text{O}_{10}(\text{OH})_8$
- 
- Garnet (red, similar to that in meta-pelitic rocks)
- $(\text{Ca,Fe,Mg,Mn})_3\text{Al}_2\text{Si}_3\text{O}_{12}$

View Epidote Structure Movie -

<http://socrates.berkeley.edu/~eps2/wisc/geo360/epidote.mov>

## Metamorphic Facies

- Different combinations of these minerals occur at different metamorphic conditions
- In 1920 Pentti Eskola, a geology professor at the University of Helsinki, Finland, introduced the idea of Metamorphic Facies
- Metamorphic Facies group minerals of rocks that experienced similar ranges of pressure and temperature during metamorphism
- Metamorphic Facies are named for minerals in metamorphosed mafic rocks or meta-basalts

Metamorphic Facies in P and T - see handout

Minerals in Moderate Pressure Metamorphic Facies (you fill them in)

Greenschist –

Epidote Amphibolite –

Amphibolite –

Granulite –

Minerals in High Pressure Metamorphic Facies

Blueschist –

Eclogite –