

**12.109 Lecture Notes**  
**September 20, 2005**

**Rock Forming Minerals IV**  
**Structure and composition of: PYRIBOLES**

Pyriboles include pyroxenes, biotite (sheet silicate), and amphiboles (chain silicates)  
VM Goldschmidt – coined term “pyribole”, invented geochemistry, 1880s

Sheet silicates (micas)

Hexagonal rings of tetrahedra

Octahedral sheet layer

Trioctahedral – all sites filled	like MgO
Diocahedral – 2/3 sites filled	like Al <sub>2</sub> O <sub>3</sub>

Brucite, gibbsite, have no tetrahedral layers (not silicates)

Mg<sub>3</sub>(OH)<sub>6</sub> and Al<sub>2</sub>(OH)<sub>6</sub>

charge balancing

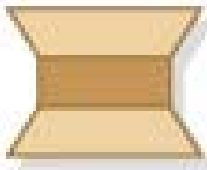
→ make a sheet silicate, add Si tetrahedrons, remove H<sup>+</sup>, satisfy charge with Si-O bond

Amphiboles

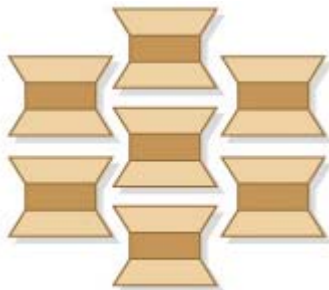
Literally a combination of 2 pyx and 1 mica

Chain silicates (double chain)

Basic amphibole unit, with tetrahedral layers sandwiching octahedra:



Arrangement of units:

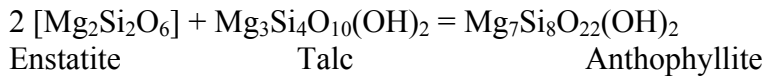
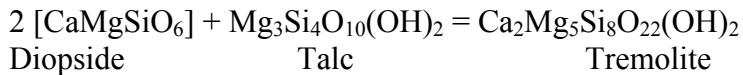


60-120 cleavage

Amphibole polytypes: (+/- signifies facing direction of silicon octahedra)

- +
- + monoclinic
- + clinoamphibole
- + C2/m
  
- +
- + orthorhombic
- orthoamphibole
- Pnma
  
- +
- +
- +
- orthorhombic
- + protoamphibole
- Pnmn

2 pyx + 1 mica = amphibole



You can build ANY amphibole this way!

Amphibole quadrilateral – graphic representation of different types of amphiboles, by composition

Jim Thompson – mixed chain width biopyriboles  
Discovered in 1970s in Chester, VT  
Chesterite, jimthompsonite, clinojimthompsonite

