

## Biaxial Minerals Descriptions

- Olivine
- Pyroxenes
  - Orthopyroxene
  - Clinopyroxene
- Amphibole
  - Hornblende
  - Actinolite
- **Micas**
  - **Biotite, muscovite, chlorite**
- Feldspars
  - Plagioclase
  - Microcline, orthoclase, sanidine

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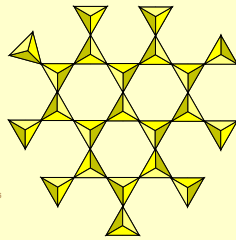
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## Micas

### Phyllosilicates

- Sheet Silicates
  - Si:O 2:5
- tetrahedra share 3 oxygen producing a 2D sheet
  - Biotite:  
 $K_2(Mg,Fe)_2AlSi_3O_{10}(OH,O,F)_2$
  - Muscovite:  $KAl_2(AlSi_3O_{10})(O,H)_2$
  - Chlorite:  
 $(Mg,Fe,Al)_3(Si,Al)_4O_{10}(OH)_2 \cdot (Mg,Fe,Al)_3(OH)_6$



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## Biotite

**Formula:**  $K_2(Mg,Fe)_2AlSi_3O_{10}(OH,O,F)_2$   
– Variable composition = variable optical and physical properties

### Refractive Index

- $n_{\alpha} = 1.522 - 1.625$
- $n_{\beta} = 1.548 - 1.672$
- $n_{\gamma} = 1.549 - 1.696$

### Relief

- moderate relief in thin section, low if Mg rich

### Birefringence and Interference Colours

- 0.03-0.07
- up to third or fourth order, a strong mineral colour may mask the interference colour

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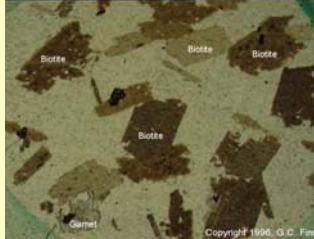
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## Biotite

### Colour and Pleochroism

- variable - brown, reddish-brown, red, green
- Strongly pleochroic with  $Z = Y > X$ . Grains are darkest colour when cleavage  $\parallel$  to lower polar.
- Colour may mask interference colour




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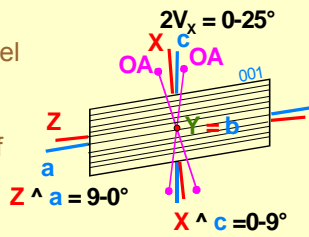
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## Biotite

### Optic Orientation

- extinction is parallel or nearly parallel, with a maximum extinction angle of a few degrees. Cleavage traces are length slow




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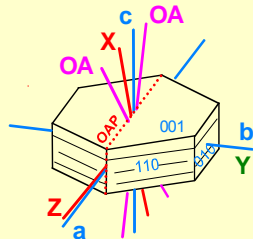
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## Biotite

### Form, Cleavage

- euhedral crystals to anhedral grains
- Tabular parallel to 001, elongated, cleavage  $\parallel$  to 001
- Hexagonal cross sections




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## Biotite

### Occurrence

- Found in igneous, metamorphic and sedimentary rocks

### Alteration

- alters to chlorite, clay minerals, and/or sericite, iron-titanium oxides, epidote, calcite, and sulphides

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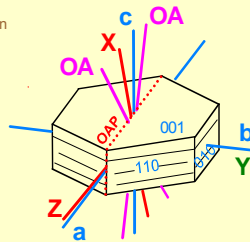
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## Biotite

### Properties

- Coloured -brown, greenish brown, reddish brown
  - Grains are darkest colour when the cleavage is parallel to the lower polar.
- Strongly Pleochroic
  - Colour for  $Z=Y>X$
- Parallel or nearly parallel extinction
  - "Bird's eye" extinction
- Length Slow
- Up to 4th order interference colours
- Biaxial negative,  $2V_x=0-25^\circ$ 
  - May appear uniaxial.



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