Due Date: Tues, November 28.
Total Points 15

- Redo Exercise 2 from Lab 15 IN ORTHOSCOPIC ILLUMINATION!!
- Overview of how to determine extinction angle, pleochroism, maximum birefringence
- Exercise on “other optical features”

Objective: Having become familiar with the optical properties of refractive index and relief, we will now become familiar with other optical properties of extinction angle, sign of elongation, pleochroism, and maximum birefringence, which aid in mineral identification

Procedure: View the thin sections indicated below and answer the related questions

1) View one of the tremolite (001) and hornblende (100) sections and determine the sign of elongation (length fast or length slow) and extinction angle (2 pts)

<table>
<thead>
<tr>
<th>Sign of Elongation</th>
<th>Extinction Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tremolite</td>
<td>length __________</td>
</tr>
<tr>
<td>Hornblende</td>
<td>length __________</td>
</tr>
</tbody>
</table>

2) View the Tremolite Bxo section. What type of extinction angle does this display relative to the cleavage? ________________________________________________ (1 pt)

3) View the glaucophane section. Note that it has three segments where the prisms of this blue pleochroic amphibole mineral are oriented in different directions. What can you say about the relationship between birefringence and intensity of pleochroic color? ________________________________________________________________ (1pt)

When you rotate the stage 360º, how many times does the most intense blue pleochroic color reappear? ____ (1pt)

Measure the extinction angle of six glaucophane crystals displaying different birefringence and take the average; are they similar? ______________ (2pts)

____º ____º ____º ____º ____º ____º AVG. ____º

What is glaucophane’s sign of elongation? Length ____________ (1pt)

4) View one of the garnet-staurolite-muscovite schist sections (3355). Name two optical features of the garnet that aid in its identification _______________________ ____________________________ (2pts)

The yellow pleochroic subprismatic mineral in the section is staurolite. Measure its extinction angle in three different crystals and determine the average: ______º ______º ______º AVG. ______º (2pts)
What is glaucophane’s sign of elongation? Length _______________ (1 pt)

The colorless micaceous mineral with the strong basal cleavage is **muscovite**. Note the flecks of light it displays at extinction; this is known as bird’s eye extinction and is common in micas. Based on the highest interference colors observed (determine order and color, e.g., 2nd Red) and assuming that the thin section is 30 microns thick, use the Interference Color Chart in the back of Klein to determine the maximum birefringence of muscovite (2 pts).

Highest interference color ________________ $\delta_{\text{max}}$ estimated _________ $\delta_{\text{max}}$ reported _____________

5) View one of the gabbro samples (DG 128). There are two high relief translucent minerals in the section* that are often difficult to distinguish in gabbroic rocks. **Augite** has a slightly brownish tint, locally shows some cleavage, and may contain biotite or opaque inclusions. **Olivine** is clearer that augite, lacks cleavage, but is often fractured, and has slightly higher relief. They also have different maximum birefringences. Determine the maximum birefringence of these minerals as done in question 4; compare you answer with the reported range in max birefringence.

**Augite**

Highest interference color ________________ $\delta_{\text{max}}$ estimated _________ $\delta_{\text{max}}$ reported _____________ (2 pts)

**Olivine**

Highest interference color ________________ $\delta_{\text{max}}$ estimated _________ $\delta_{\text{max}}$ reported _____________ (2 pts)

Why do these phases have a range in birefringence? ________________________________________________

______________________________________________________ (1pt)

* the other minerals in the section are twinned plagioclase and opaque magnetite rimmed by minor biotite.