LECTURE SIX: Extinction Angle and Pleochroism

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- Sign of Elongation
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- Extinction in Uniaxial Minerals
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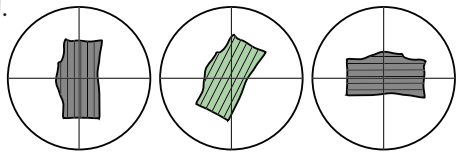
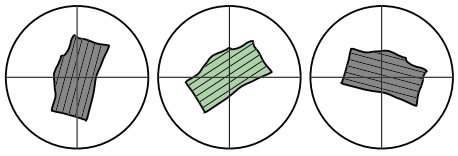
There are four categories of extinction
- Parallel extinction
- Inclined extinction
- Symmetrical extinction
- No extinction angle

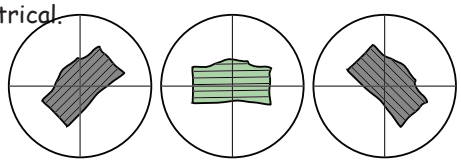
Parallel Extinction
- With parallel extinction the mineral is extinct when the cleavage or length is aligned parallel to one of the cross hairs.
- The extinction angle is 0°.
- Either the slow ray or fast ray vibration direction is parallel to the trace of cleavage or length of the mineral.



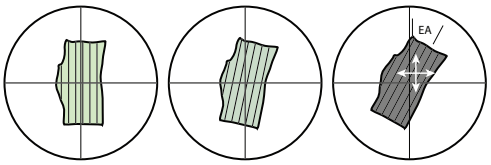
Inclined Extinction
- With inclined extinction the mineral is extinct when the cleavage of length is aligned parallel to one of the cross hairs.
- The extinction angle will be greater than 0°.
- Neither vibration direction is aligned parallel to the trace of the cleavage of the length of the mineral.
- If the slow ray vibration direction is closest to the length or trace of cleavage, the mineral is length slow. If the fast ray is closest the mineral is length fast.



Symmetrical Extinction
- Symmetrical extinction may be observed in minerals that display either two cleavages or two distinct crystal faces.
- If the extinction angles EA1 and EA2 measured from the two cleavage or crystal faces to the same vibration direction, are the same, extinction is symmetrical.



Determining the Extinction Angle
The angle between the length or a prominent cleavage in a mineral and a vibration direction is a diagnostic property called the extinction angle.



To determine the extinction angle
- Rotate the stage of the microscope until the length or cleavage of the mineral is aligned with the north-south cross hair.
- Record the reading from the stage goniometer at this point (g1)
- Rotate the stage until the mineral goes extinct (dark)
- Record the new reading from the goniometer (g2)

The extinction angle is the difference between G1 and G2.
If the extinction angle measured by rotating the stage clockwise is EA, then the extinction angle measured by rotating the stage anticlockwise is 90°-EA. Normally the smaller angle is reported.

Extinction in Uniaxial Minerals
- Tetragonal and many hexagonal minerals are prismatic and either elongate or stubby parallel to the c-axis.
- A sample with the highest birefringence will have its c-axis parallel to the microscope stage and will display parallel extinction to prismatic cleavage and inclined or symmetrical extinction to rhombohedral or pyramidal cleavage.
- Extinction is parallel to {001} cleavage in all grain orientations.

Extinction in Biaxial Minerals
- Orthorhombic minerals display parallel or symmetrical extinction in sections cut parallel to (100), (010) and (001) and inclined extinction in random orientations.
- Grains cut to yield maximum retardation always display parallel or symmetrical extinction.
- Monoclinic minerals display parallel or symmetrical extinction if {010} happens to be vertical and inclined extinction is most other orientations.
- Triclinic minerals display inclined extinction in most orientations.

Pleochroism
- Pleochroic minerals change color as the stage is rotated when the sample is observed in plane light.
- The color changes because the fast and the slow rays are absorbed differently as they pass through the mineral and therefore have different colors.
- When the fast ray vibration direction is parallel to the lower polariser, all light passes as the fast ray, so the mineral displays that color.
- When the slow ray vibration direction is parallel to the lower polariser the minerals displays the color of the slow ray.
- If the stage is rotated to allow both the slow and the fast rays to come through, the perceived color is usually an intermediate between the two colors.

Isotropic Minerals
- Isotropic minerals are not pleochroic because they do not experience double refraction.
- In plane light, isotropic minerals display a uniform color as the stage is rotated.

Anisotropic Minerals
- Colored uniaxial minerals are usually pleochroic which can be sufficiently described by identifying the colors of both the ordinary and extraordinary rays
- To describe the pleochroism of biaxial minerals it is necessary to specify three colors in directions X, Y and Z