

LECTURE THREE: Relief and Becke Lines

IN THIS LECTURE

- Relief
- Types of Relief
- Relief in Anisotropic Minerals
- +ve or -ve Relief
- The Becke Line
- The Lens Effect
- Internal Reflection Effect
- Measuring Becke Line Movement
- Dispersion and Becke Lines

Types of Relief

When examining minerals you can have:

Strong relief

- mineral stands out strongly from the mounting medium, whether the medium is oil, in grain mounts, or other minerals in thin section,
- for strong relief the indices of the mineral and surrounding medium differ by greater than 0.12 RI units.

Moderate relief

- mineral does not strongly stand out, but is still visible,
- indices differ by 0.04 to 0.12 RI units.

Low relief

- mineral does not stand out from the mounting medium,
- indices differ by or are within 0.04 RI units of each other.

Relief of Anisotropic Minerals

The relief of anisotropic minerals in both grain mounts and thin section may change as the microscope stage is rotated in plane light

This is because the fast and the slow rays have different indices of refraction therefore display different relief depending on which ray is dominant

This is particularly so of minerals with moderate to high birefringence where the difference between the fast and slow rays is more pronounced

Becke Lines

To determine whether a mineral has positive or negative relief, the Becke Line method is used.

Becke Lines are a band or rim of light visible along the grain boundary in plane light when the grain mount is slightly out of focus.

The Becke line may lie inside or outside the mineral grain depending on how the microscope is focused

To observe the Becke line: (1) use medium or high power, (2) close aperture diagram, (3) for high power flip auxiliary condenser into place.

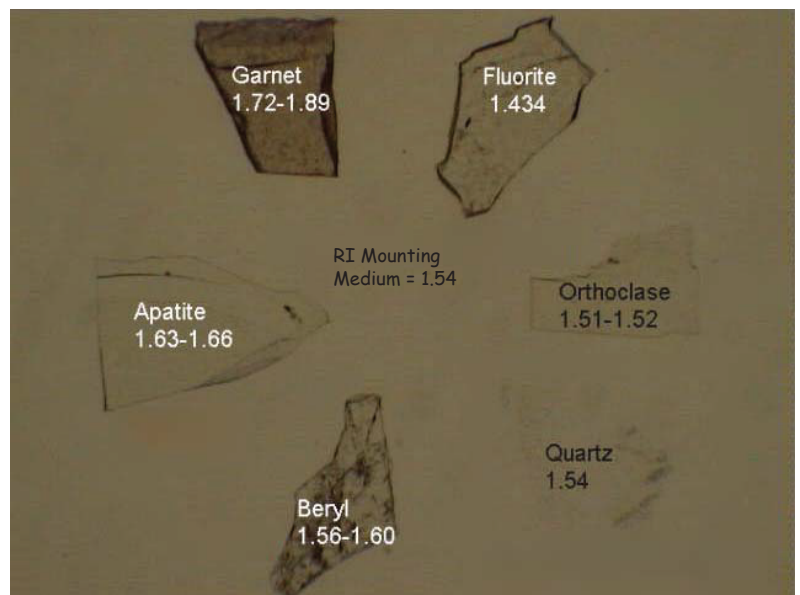
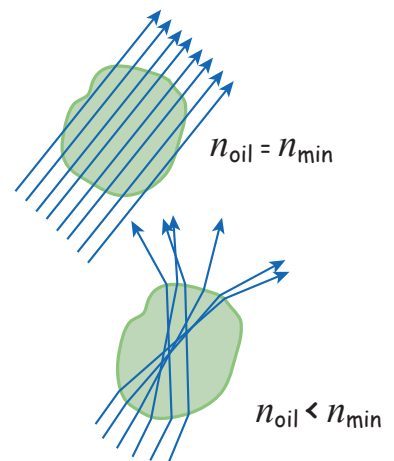
The direction of movement of the Becke Line is determined by lowering the stage with the Becke Line always moving into the material with the higher refractive index.

Relief

Relief can be defined as the degree to which a mineral grain or grains appear to stand out from the mounting material, whether it is an immersion oil, Canada balsam or other medium, or another mineral.

If the indices of refraction of the oil and mineral are the same, light passes through the oil-mineral boundary un-refracted and the mineral grains do not appear to stand out.

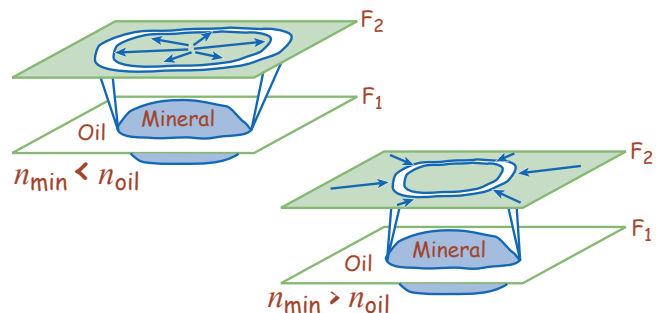
If $n_{oil} \neq n_{mineral}$ then the light travelling through the oil-mineral boundary is refracted and the mineral grain appears to stand out.



Positive or Negative Relief

A mineral may exhibit positive or negative relief. For a mounting medium with an RI of 1.54:

- (1) +ve relief - index of refraction for the material is greater than the index of the oil e.g. garnet 1.76
- (2) -ve relief $n_{min} < n_{oil}$ e.g. fluorite 1.433



If $n_{min} < n_{oil}$, the cone diverges upwards and if $n_{min} > n_{oil}$ the cone converges upwards. If the stage is lowered, the plane of focus goes from F_1 to F_2 and the Becke Line appears to move towards the material of the higher refractive index.