Lab Notes
Sept. 13, 2005

## Optics

Index of refraction
$n_x = v_{vacuum}/v_x$

LIGHT PATH THROUGH MICROSCOPE:

white light into microscope

→

Polarizer, now plane polarized white light

→

Stage wi. Mineral
**If material is isotropic** (amorphous or highly symmetrical crystal), light changes speed in crystal but not polarization
**If anisotropic**, light travels at different speeds in different directions through crystal, resolves into perpendicular polarized components. One component lags behind the other in phase because of the difference in indices of refraction n, when recombines above crystal, interference ➔ circularly polarized light, different wavelengths in white light + interference ➔ interference colors, BIREFRINGENCE

→

Polarizer, for crossed polars

Under crossed polars, isotropic materials are black, and anisotropic materials show birefringence.
Path difference changes interference
offset due to different light speeds in different directions in mineral
white light has many different wavelengths in it
Interference makes some wavelengths extinct, some bright → white light becomes colored light
interference colors depend on type of mineral, angle, thickness of thin section

Optical indicatrix (review from 12.108) – ellipsoid with radius = value of n in that direction. For isotropic minerals, indicatrix is spherical.

Relief
Mineral property, examined under plane polarized light

Relative difference in refractive index between mineral and its surroundings, determined visually in PPL
Used to estimate n, the refractive index
Relief can be positive or negative
Becke lines → tell sign of relief
Caused by differences in speed of light, defocuses at edges of grains
If lines move in with increased distance from stage, negative

Epoxy n = 1.54
Quartz n = 1.54-1.55
Garnet n = 1.72-1.89

Uniaxial indicatrices
Typical of tetragonal, hexagonal minerals

[picture]

1 circular section, all other directions ellipses
Radius of circle represents refractive index ω, ray in this direction called "ordinary"
c axis perpendicular to circular section has refractive index ε, ray in this direction "extraordinary"
oblate = ω>ε, prolate = ε>ω

calcite dots experiment:
dot on paper
place down calcite crystal
see 2 dots, one looks closer than the other
rotate crystal, one dot revolves around the other
place polarizing filter on crystal, rotate, the dots will alternate bright and dim with direction