Basic Soil Mineral Identification
Using A Polarizing Light Microscope

Quartz

Plane-polarized light

- colorless
- n = 1.54
- grains may appear entirely clear; little evidence of weathering is present; may exhibit conchoidal fractures - cleavage traces are absent

Cross-polarized light

- relatively high interference colors possible, depending on grain thickness
- extinction is often sharp, but may appear undulatory (extinction sweeps across grain as stage is rotated)

Mica

Plane-polarized light

- colorless (muscovite) to dark brown (biotite)
- high relief in most oils; n = ~1.55 - 1.61 (muscovite); ~1.61-1.70 (biotite)
- grains appear platy – we are always looking down the c-axis
- may appear pitted, 'dirty', or otherwise weathered

Cross-polarized light

- very low interference colors are observed because of orientation; may be hard to observe due to grain color
- extinction is not sharp – the grain may appear to remain extinct or nearly extinct upon rotating the stage
- may have mottled appearance

Feldspars

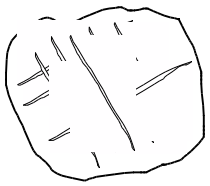
Plane-polarized light

- colorless
- n is variable, depending on feldspar type and orientation; n = ~1.518 - 1.539 (for anorthite, n = 1.577 – 1.590)
- cleavage traces can often be seen and make angles of close to 90°
- may appear pitted, 'dirty', or otherwise weathered

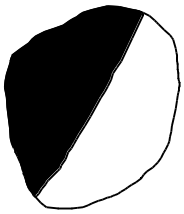
Cross-polarized light

- interference colors are about the same as for quartz
- extinction is similar to quartz, unless twinning or intergrowth textures are present; if twinning is present, patterns of light and dark portions of the crystal will alternate as the stage is rotated

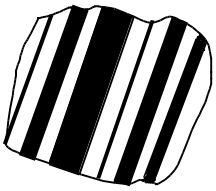
tartan or grid twinning (microcline)



simple twinning (orthoclase)



polysynthetic twinning (plagioclase)



Glass (including volcanic glass, phytoliths)

Plane-polarized light
- clear
- variable n

Cross-polarized light
- isotropic (always extinct)

Other Minerals (garnet, tourmaline, kyanite, pyroxenes, amphiboles, olivine, magnetite, zircon, etc.)

Plane-polarized light
- some are opaque (e.g. magnetite, rutile)
- often strongly colored: green, brown, amber, etc.
- cleavage traces can often be seen and make various angles (Ex. hornblende has 60°-120° cleavage angles)

Cross-polarized light
- often high interference colors
- opaques remain black
- if a grain has a long axis, the angle of extinction can be measured (align long axis with x-axis of stage, read scale, rotate stage until grain is extinct, read scale, subtract for extinction angle)

Terminology

Anisotropic mineral – a mineral in which light travels at different speeds as a function of the direction of vibration within the crystal

Becke line – thin line of white or colored light near the grain boundary; upon racking up (raising objective lens), Becke lines will appear to move into the medium having the higher refractive index

Birefringence – possession of more than one index of refraction; the greater the difference between these indices, the greater the birefringence

Extinction – in cross-polarized light, a mineral grain appears black every 90° as the stage is rotated; the grain is said to be extinct when it is black

Interference colors - in cross-polarized light, the appearance of colors that are related to the birefringence and thickness of a mineral grain

Isotropic mineral – a mineral in which light travels with the same speed regardless of its direction of vibration

Refractive index (n) – the ratio of the velocity of light in a vacuum to its velocity through a mineral; for most minerals, $1.50 < n < 1.80$

Relief – refers to how sharply the outlines of a mineral grain 'stand out' from the medium surrounding it; for positive relief: $n_{grain} > n_{oil}$; for negative relief: $n_{grain} < n_{oil}$; for 0 relief: $n_{grain} = n_{oil}$;