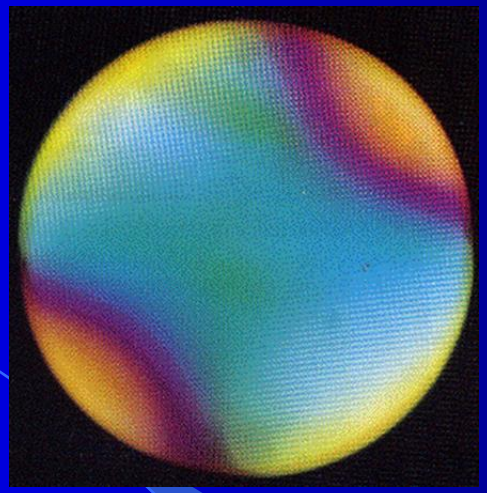
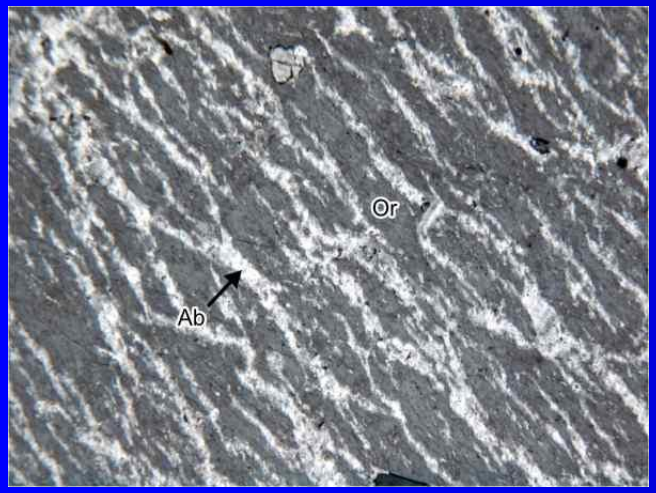
Mineralogical Features Observed with Polarizing Light Microscopy

Uniaxial figure

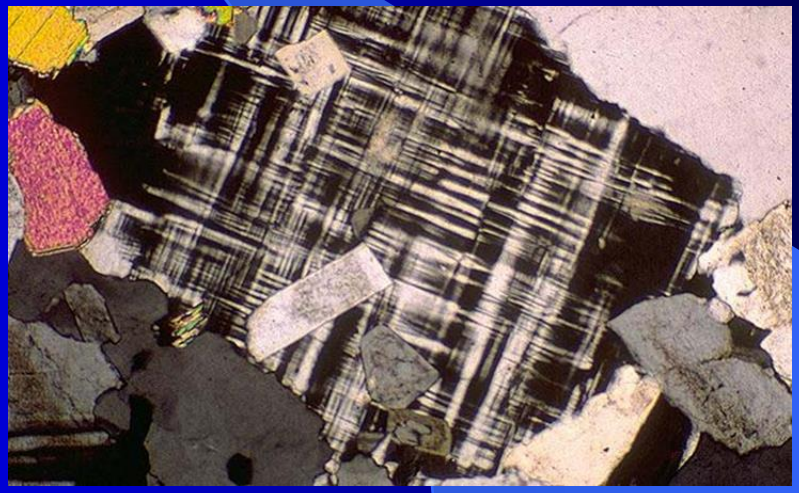


Biaxial figure

Albite twins



Perthite



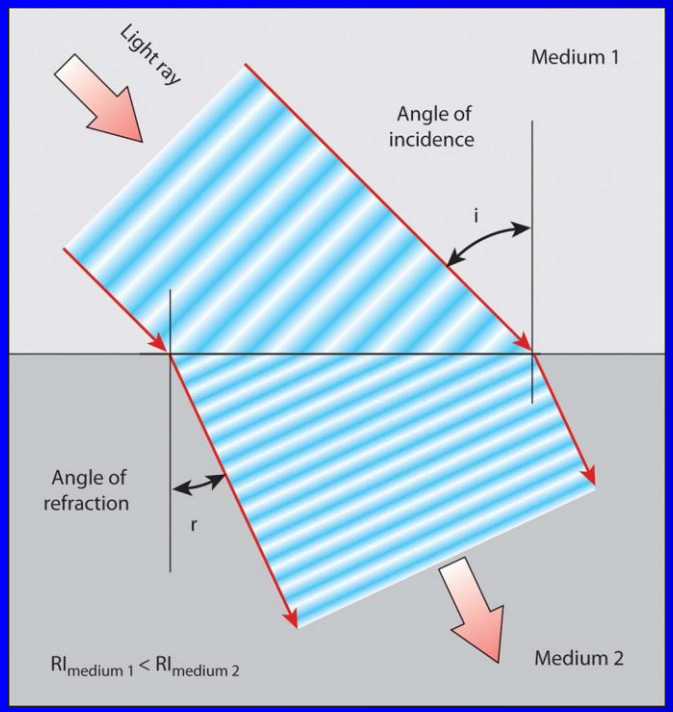
Tartan (gridiron) twinning

Refractive Index and Angle of Refraction

$$Refractive\ Index(R.I.) = \frac{velocity\ of\ light\ in\ a\ vacuum}{velocity\ of\ light\ in\ a\ medium}$$

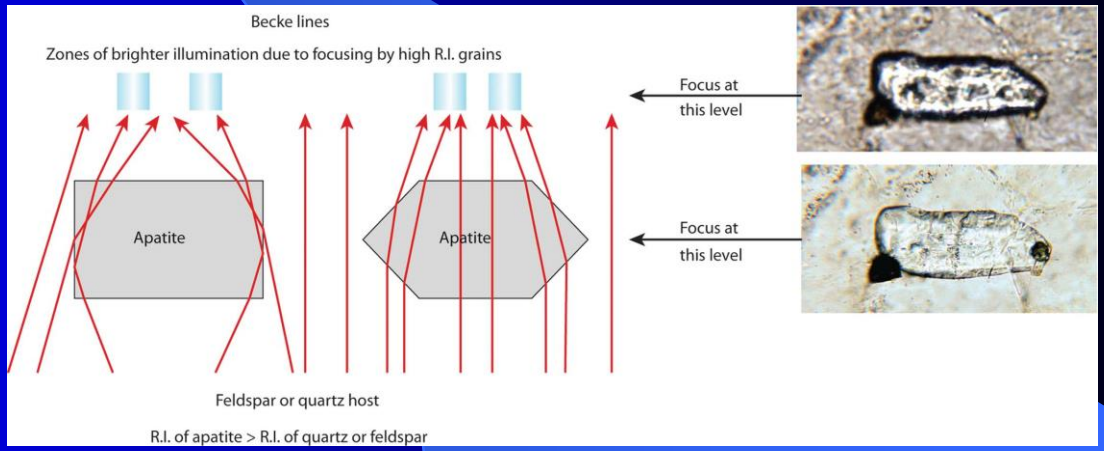
The refractive index varies with the wavelength of light.

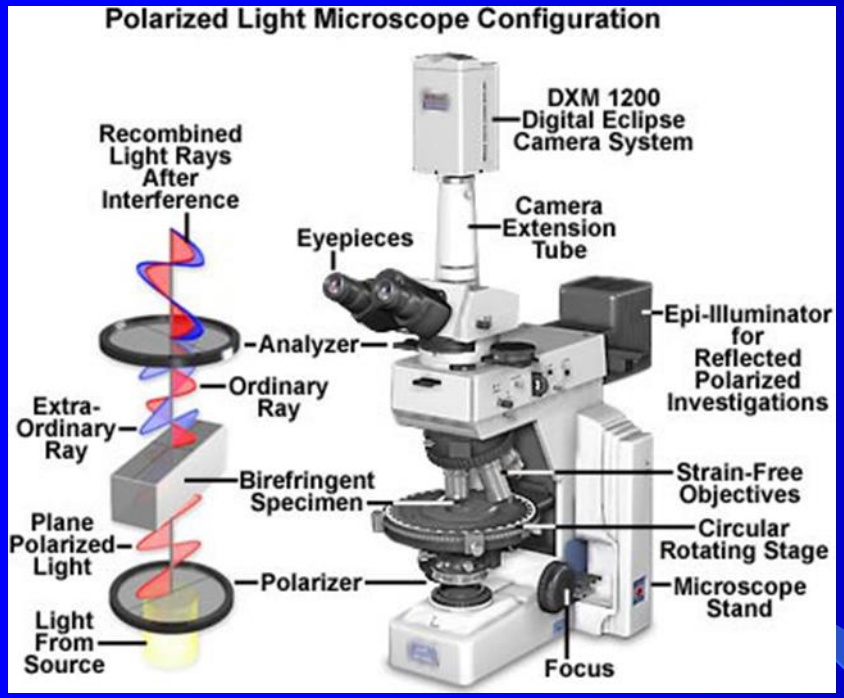
Becke Lines – Super Important

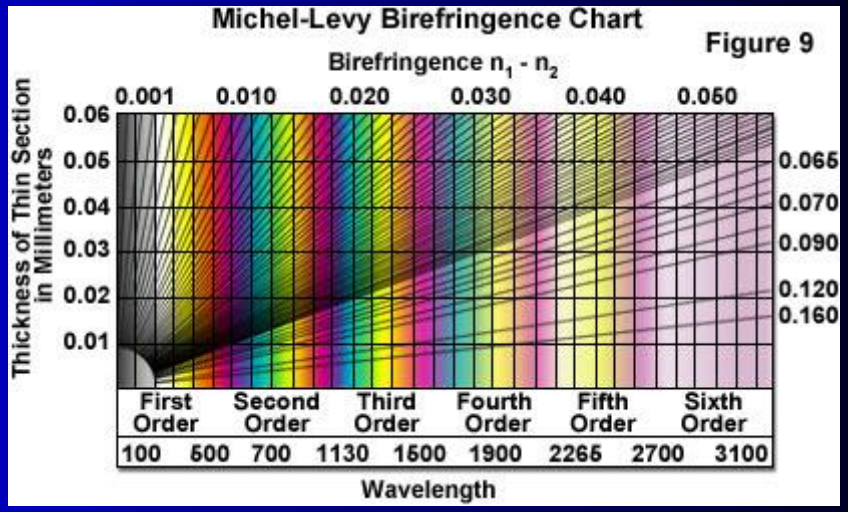


Refraction – Snell's Law

$$\frac{\sin i}{\sin r} = \frac{R.I.2}{R.I.1}$$

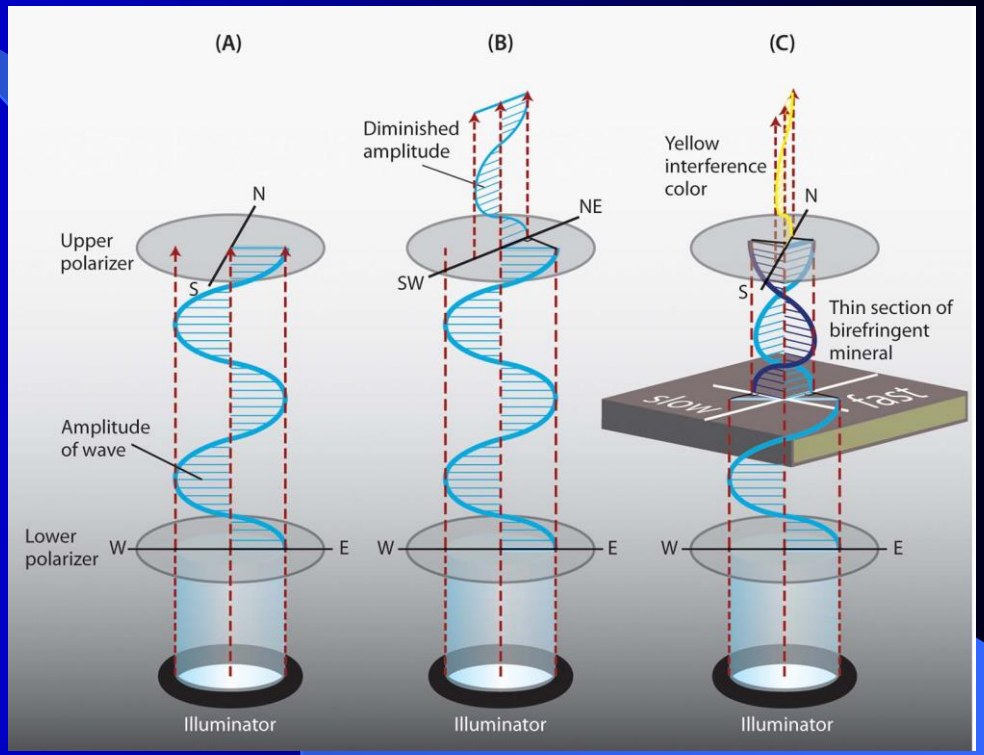




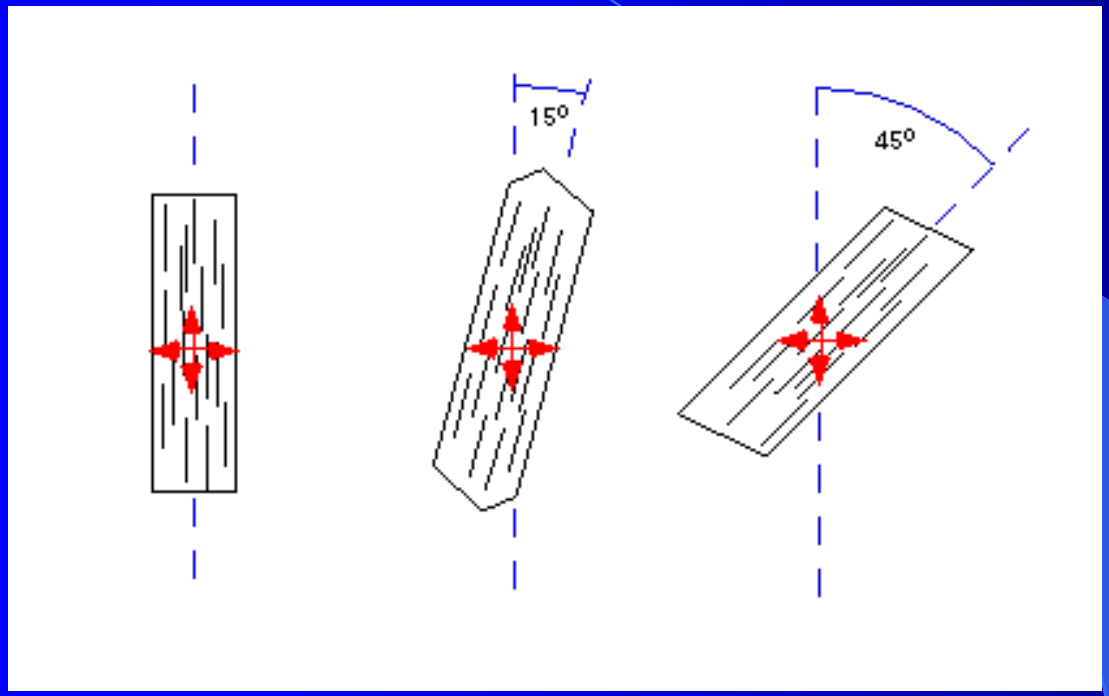


Birefringence – difference between maximum and minimum refractive indexes.

Retardation – amount by which the fast and slow light waves are out of phase. Function of birefringence and thickness of the mineral.



Extinction occurs when one of the vibration directions in the crystal parallels the E-W polarizer. In this case the polarized light is not split into two rays vibrating at right angles to each other. When the E-W vibrating ray encounter the upper polarizer which only permits rays vibrating in the N-S direction to pass, the crystal goes to extinction (becomes dark). The relationship between this angle and crystallographic directions can be an important piece of diagnostic information. Extinction can be parallel, inclined, or symmetrical.



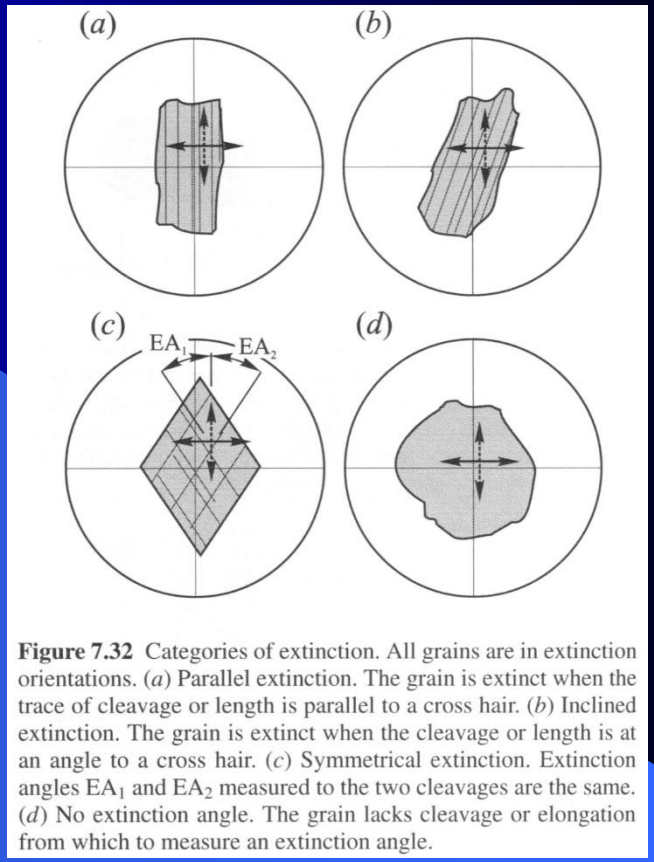
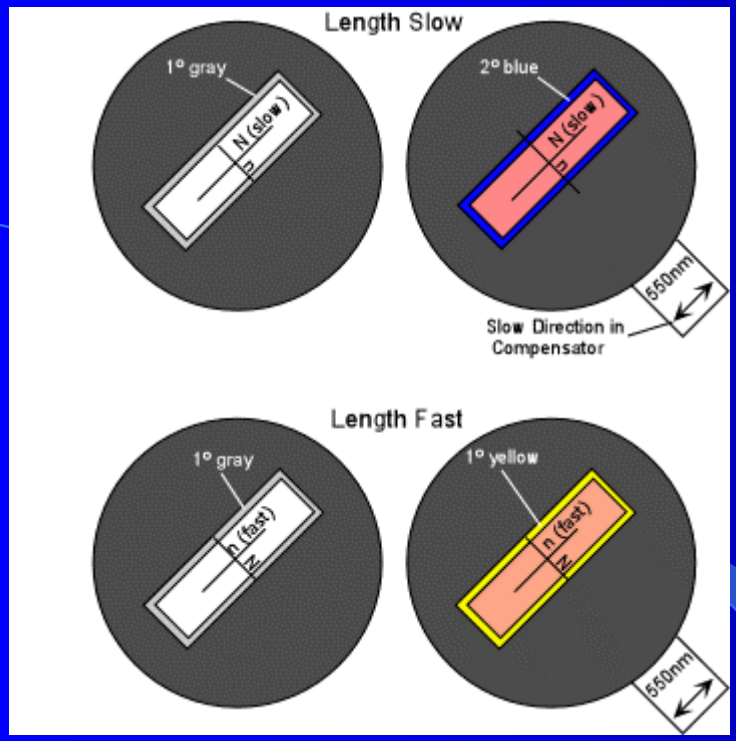
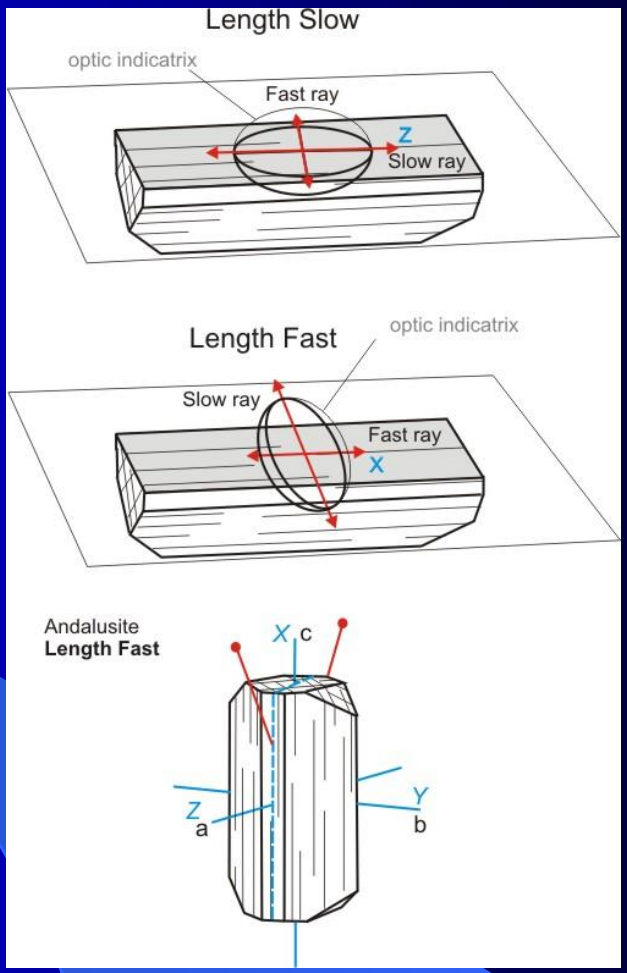
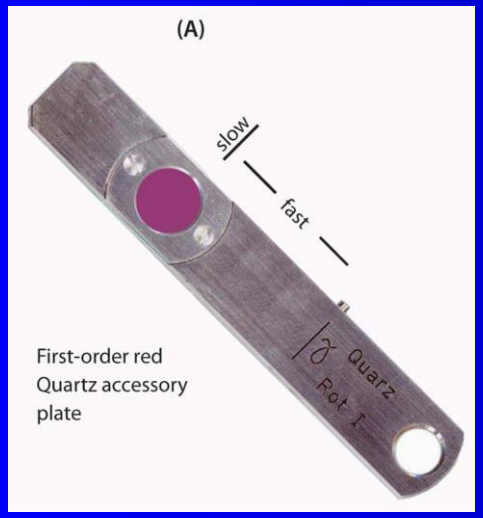


Figure 7.32 Categories of extinction. All grains are in extinction orientations. (*a*) Parallel extinction. The grain is extinct when the trace of cleavage or length is parallel to a cross hair. (*b*) Inclined extinction. The grain is extinct when the cleavage or length is at an angle to a cross hair. (*c*) Symmetrical extinction. Extinction angles EA_1 and EA_2 measured to the two cleavages are the same. (*d*) No extinction angle. The grain lacks cleavage or elongation from which to measure an extinction angle.

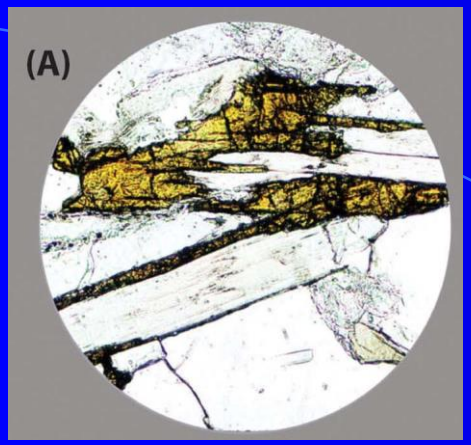
Sign of Elongation

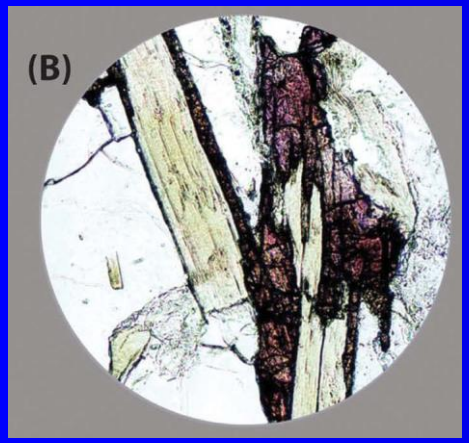




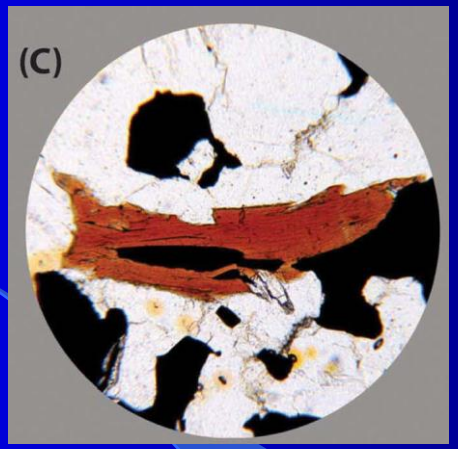


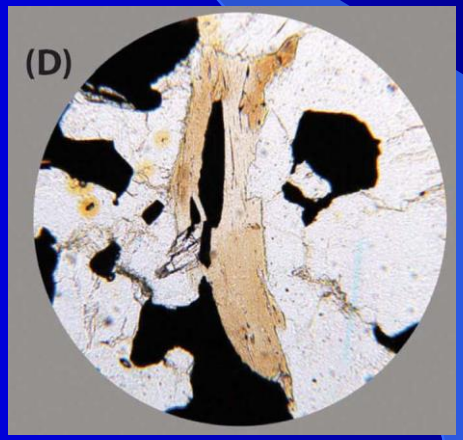
Pleochroism is the change in color that occurs when a mineral is rotated under plane-polarized light. This is due to the selective adsorption of certain wavelengths of light which causes the transmitted light to appear colored. The pleochroic colours are at their maximum when light is polarized parallel with a crystallographic axis. The axes are designated X, Y and Z. An absorption formula records the amount of absorption parallel to each axis in the form of X < Y < Z with the left most having the least absorption and the rightmost the most.



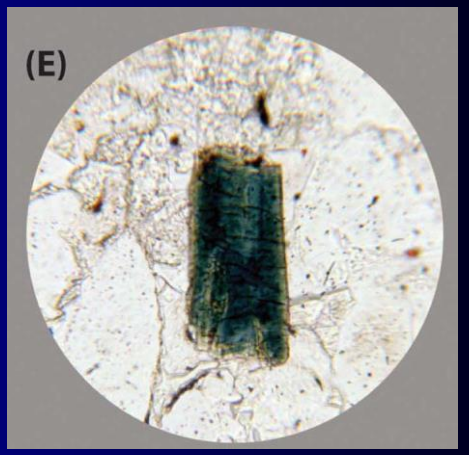


Manganese epidote piemontite





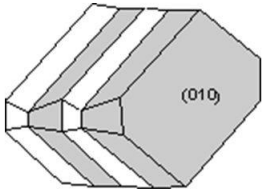
Biotite absorption is greater when cleavage parallels polarizer.

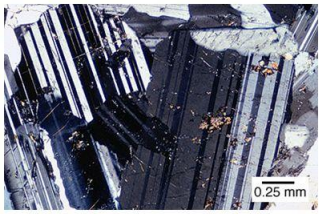


Tourmaline absorbs more light when the long axis of the crystal is perpendicular to the polarizer.

Albite Twinning

Polysynthetic Twinning





- A type of multiple contact twinning is called polysynthetic
- The compositions surfaces are parallel to one another, they are called ***polysynthetic***
- Plagioclase commonly shows this type of twinning, called the Albite Twin Law, with {010} as the twin plane
- Such twinning is one of the most diagnostic features of plagioclase

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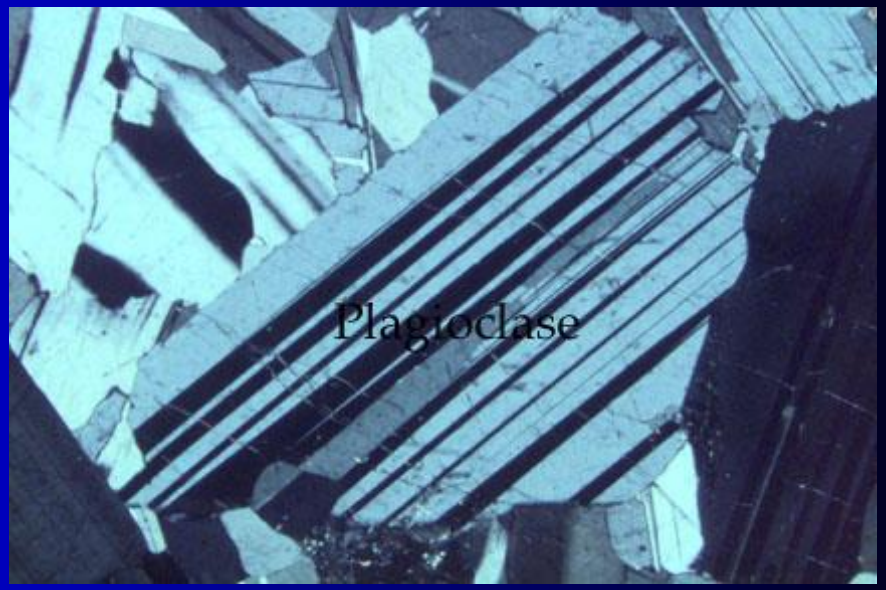
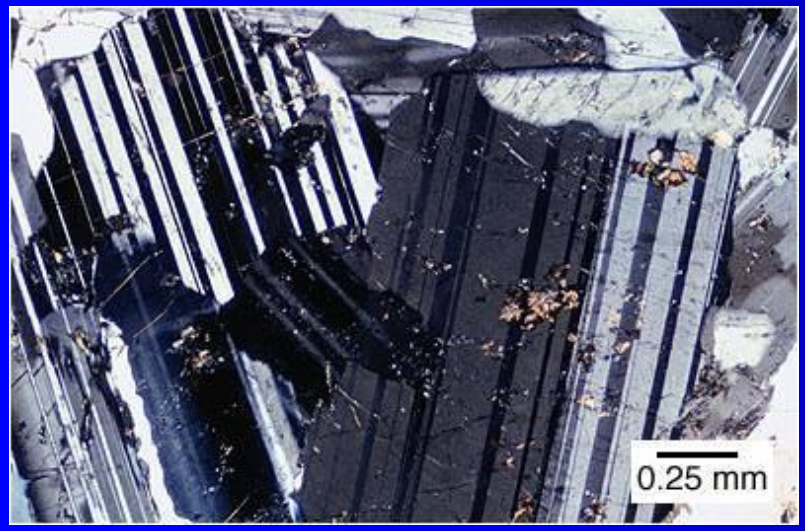
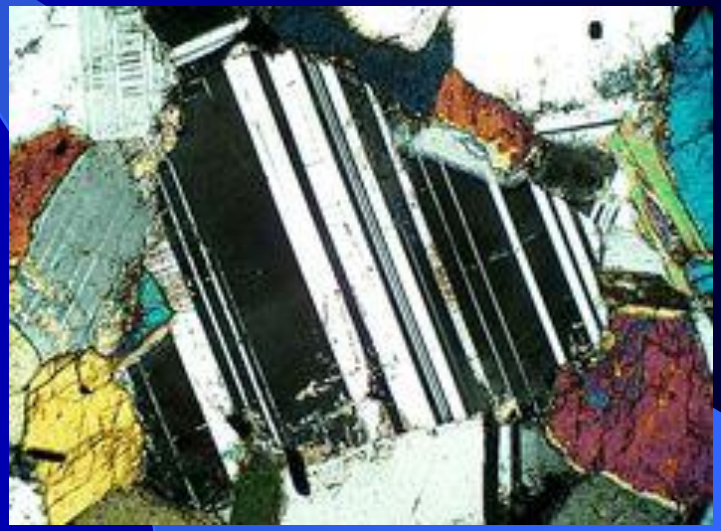
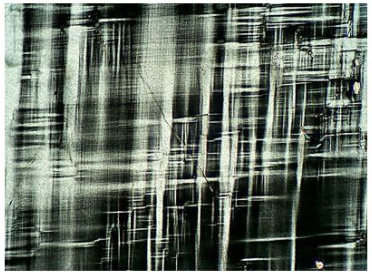




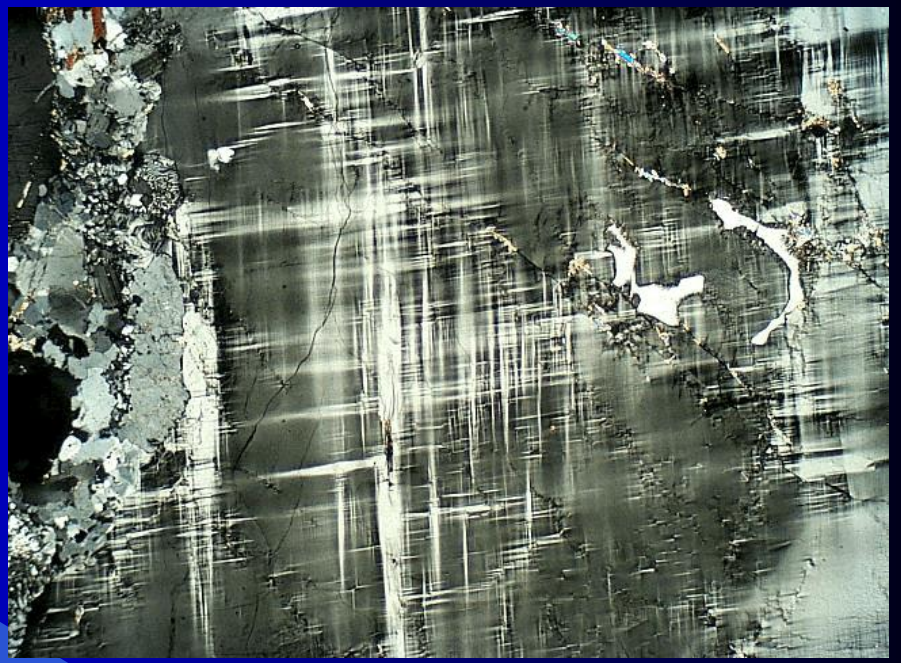


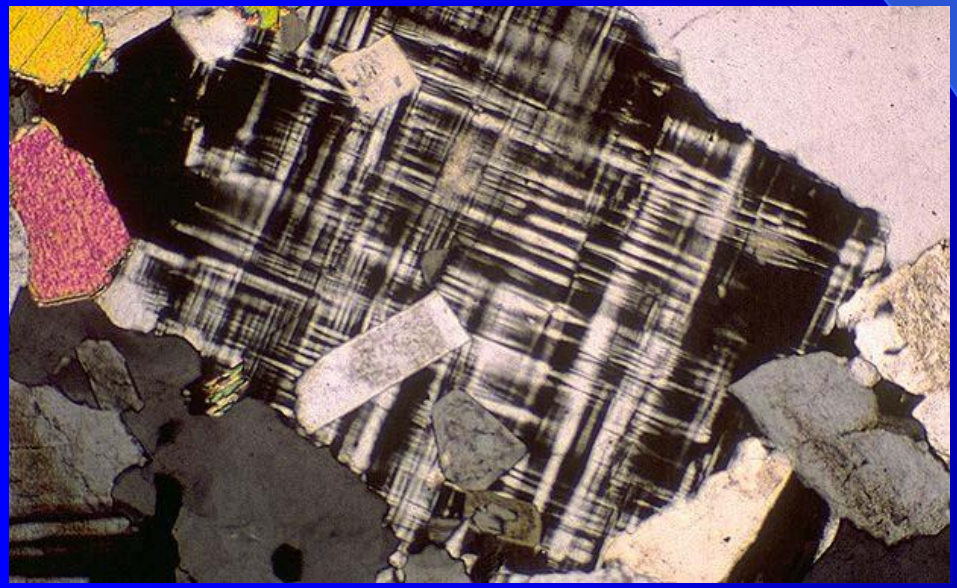
Tartan Twinning

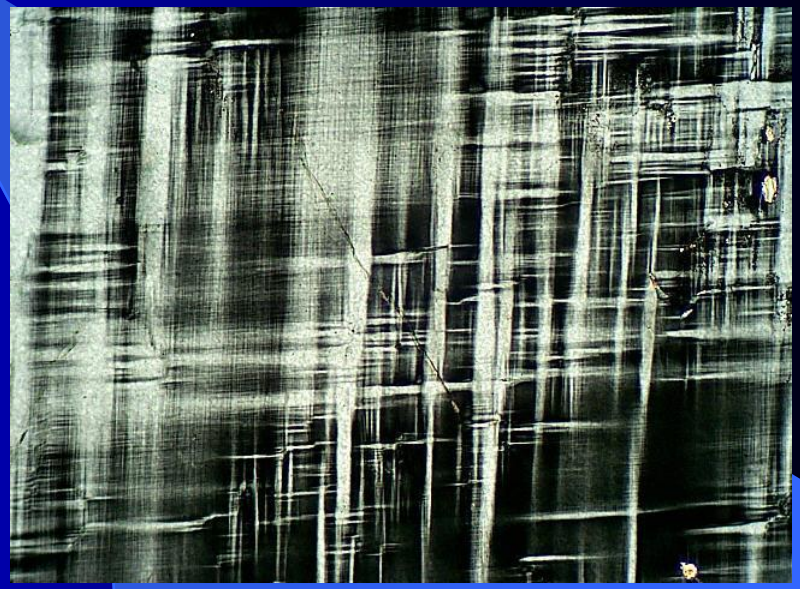


Tartan Twinning

- Combination of albite twinning and pericline twinning in alkali feldspar results when high temperature sanidine (monoclinic) transforms to low temperature microcline (triclinic) is known as "tartan“, “gridiron, or “cross-hatch” twinning pattern
- One of the most characteristic diagnostic properties for the identification of microcline

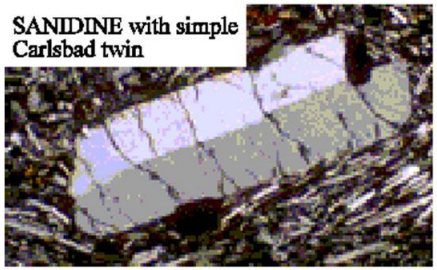






Carlsbad Twinning

Carlsbad Twin Photo



- Carlsbad twins are seen as a pair of individual crystals, separated by a single line, in thin section

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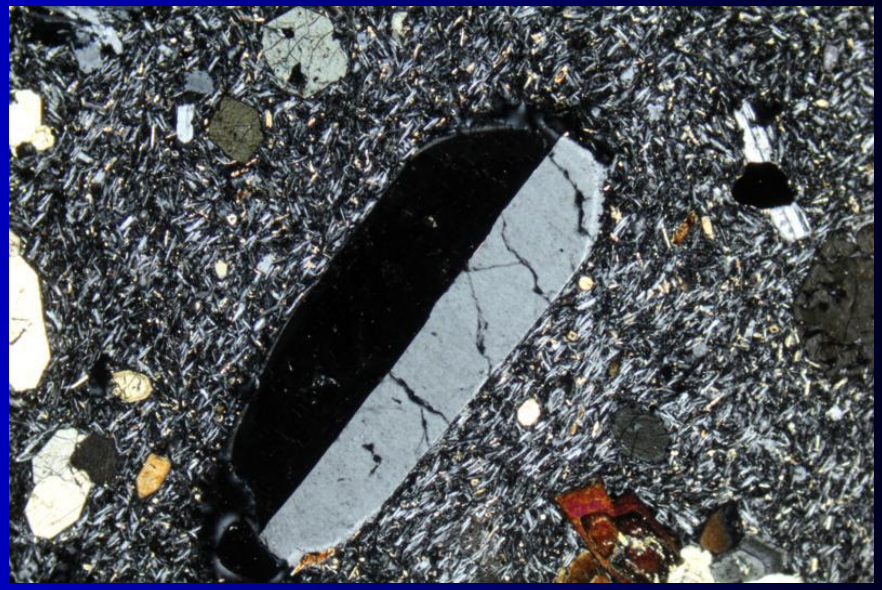
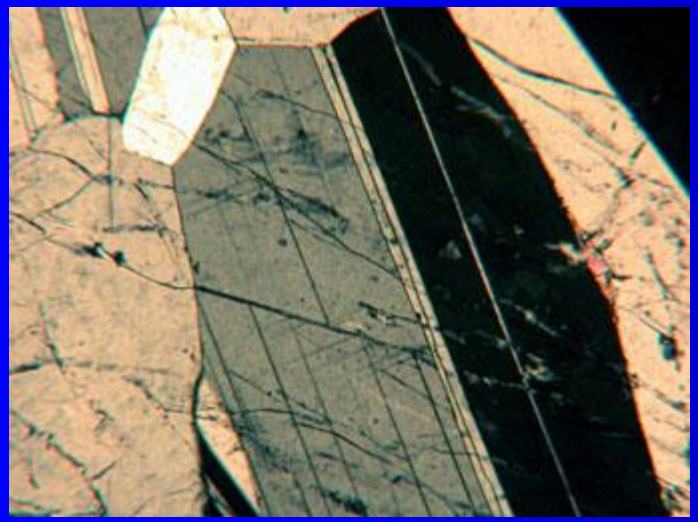
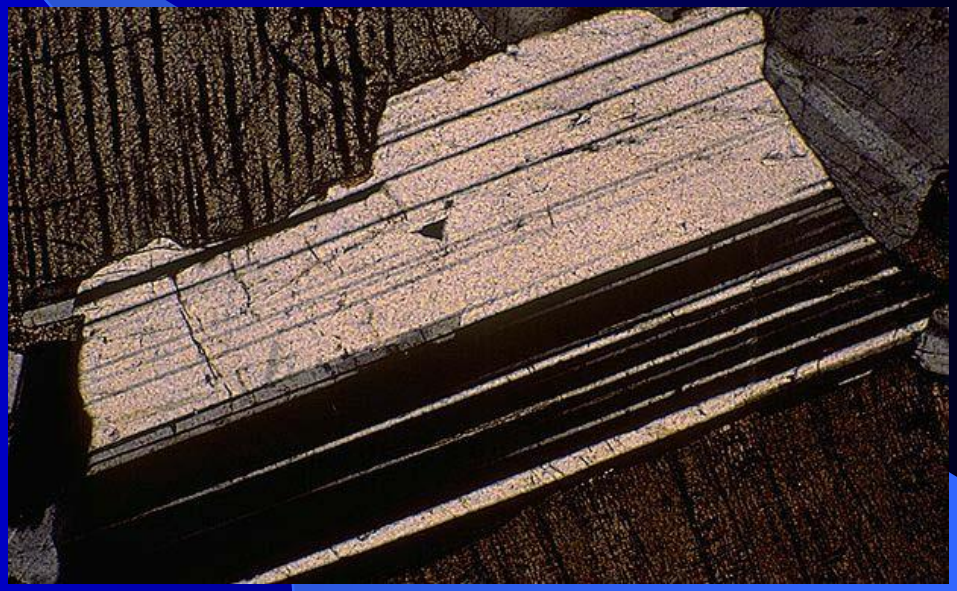


Carlsbad-Albite Twinning





Perthites – plagioclase exsolved in K-feldspar

Perthite Photo

- Perthite, as a result of exsolution
- Microperthitic demixing of high temperature mixed crystals with chemical composition (K, Na)$AlSi_3O_8$ into Albite, $NaAlSi_3O_8$ (light) and Orthoclase, $KAlSi_3O_8$ (dark)

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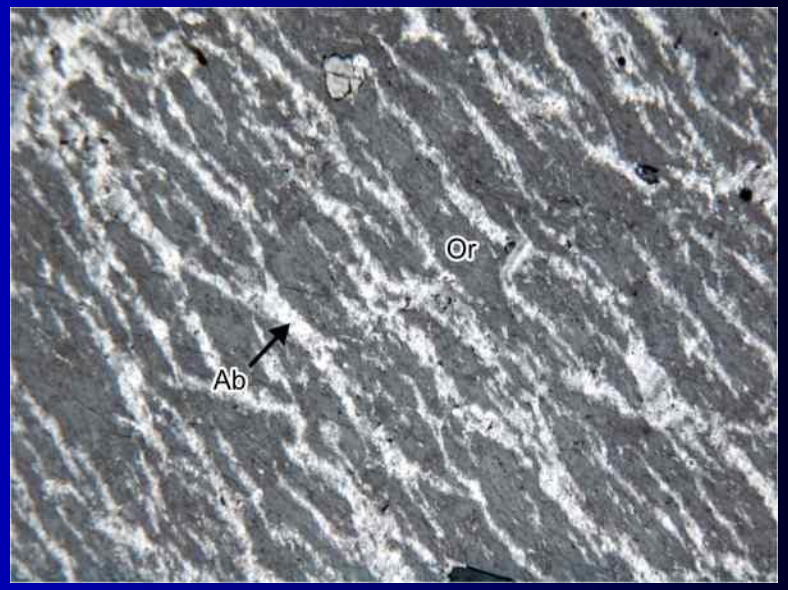
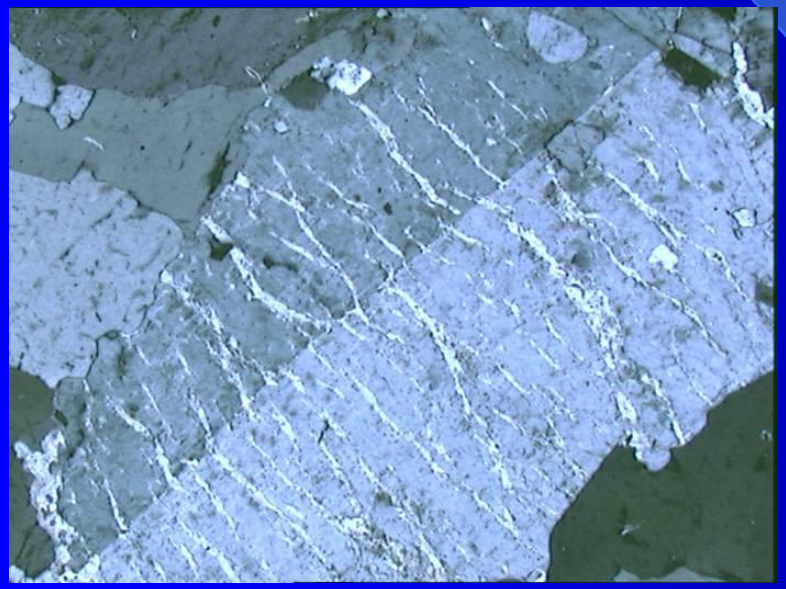
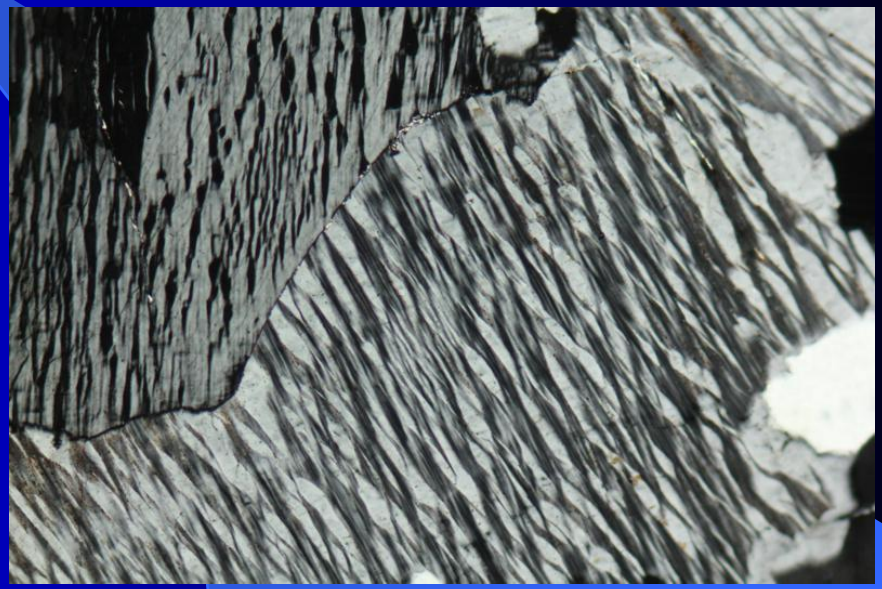
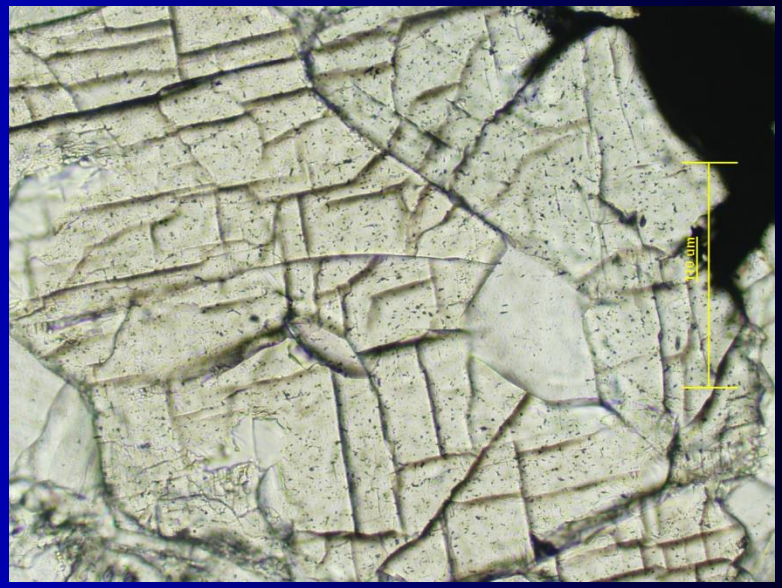


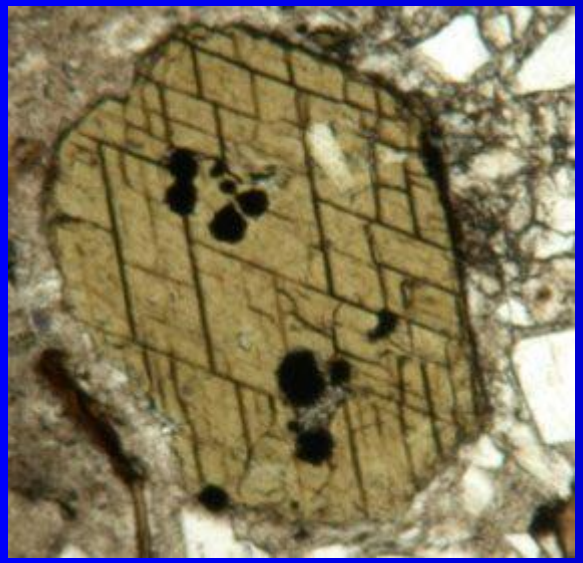


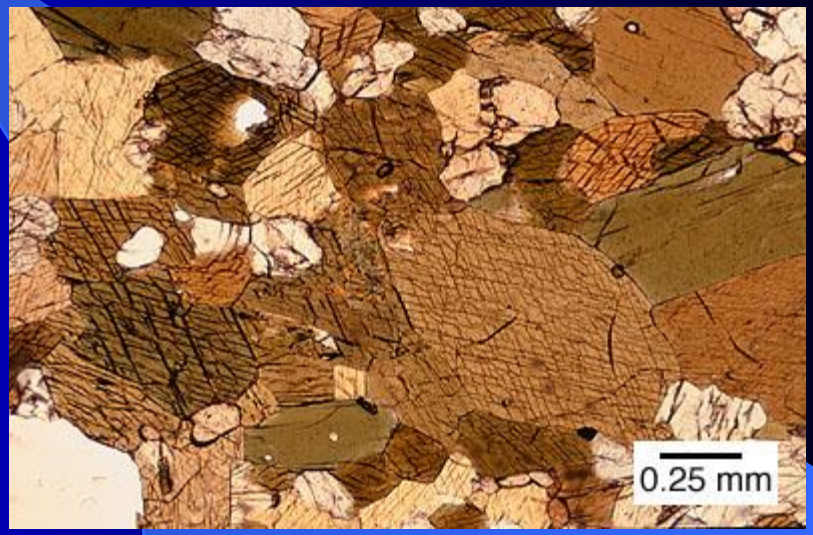


Cleavage in Pyroxenes – two cleavage directions at 90°

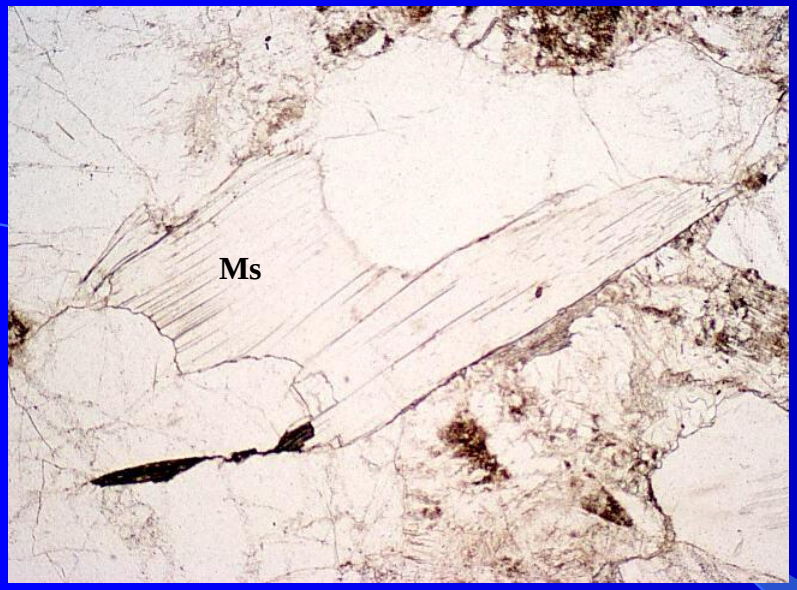


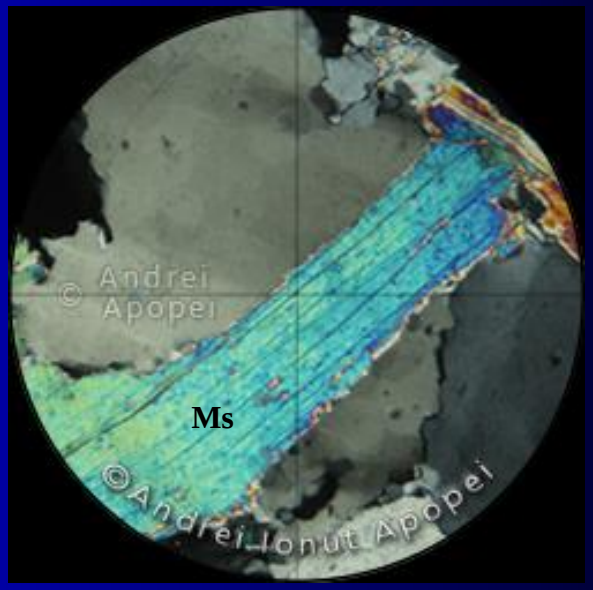
Cleavage in Amphiboles – two cleavage directions at 60° and 120°

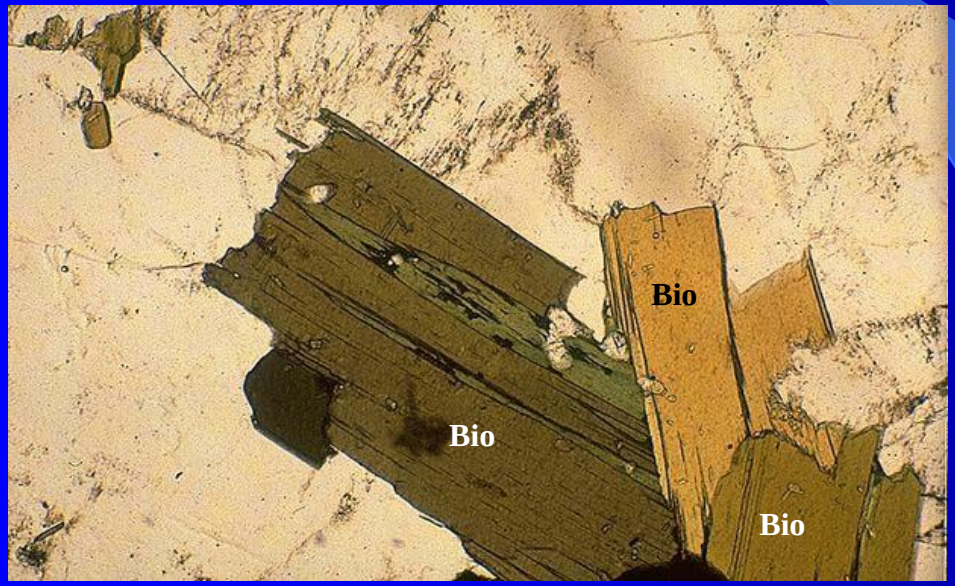


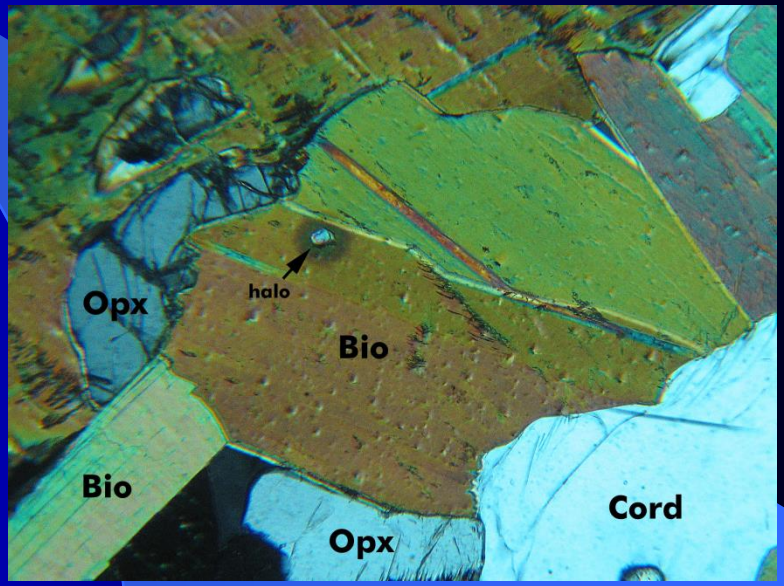


Micas in plane light (left) and crossed polars (right)









Using Albite twins to determine the composition of plagioclase

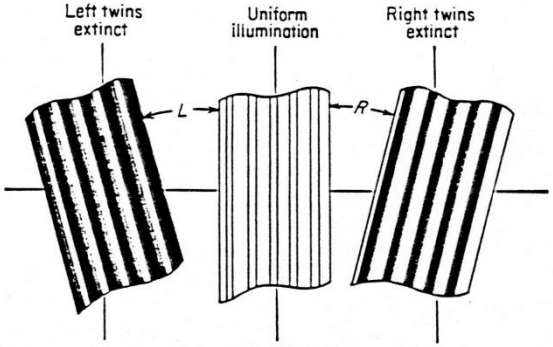


FIG. 13-25. Diagram showing the method of determining the extinction angles in albite twins cut normal to (010) for the plagioclase feldspars (the method of Michel-Lévy).

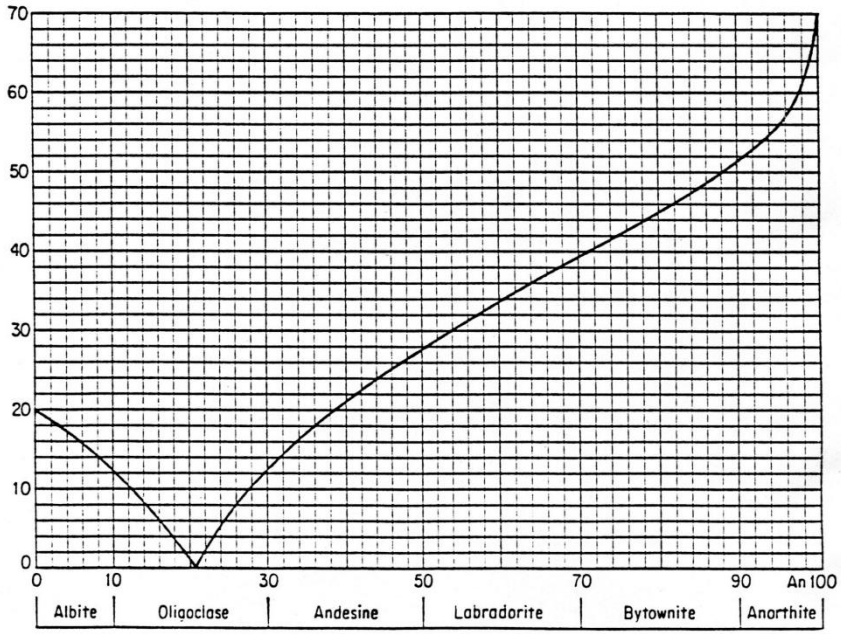
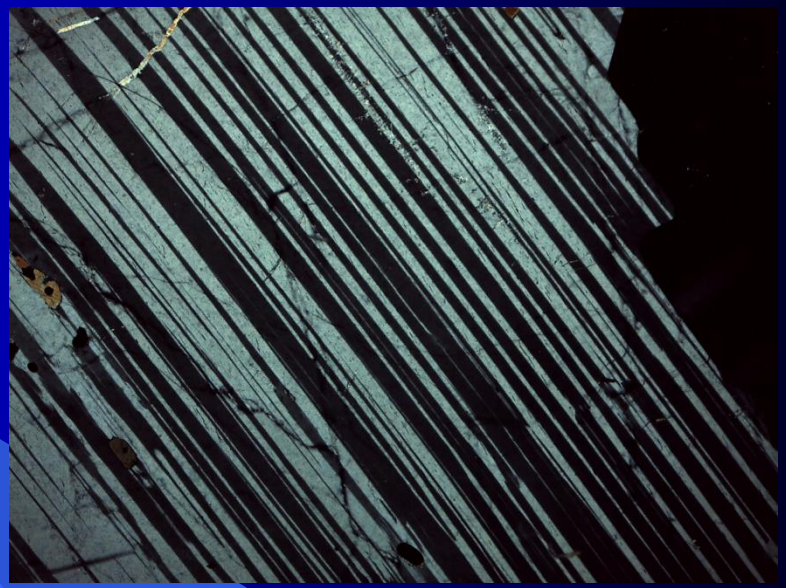


FIG. 13-26. Curve showing the maximum extinction angle of albite twins cut normal to (010) for the plagioclase feldspars (Michel-Lévy's method).



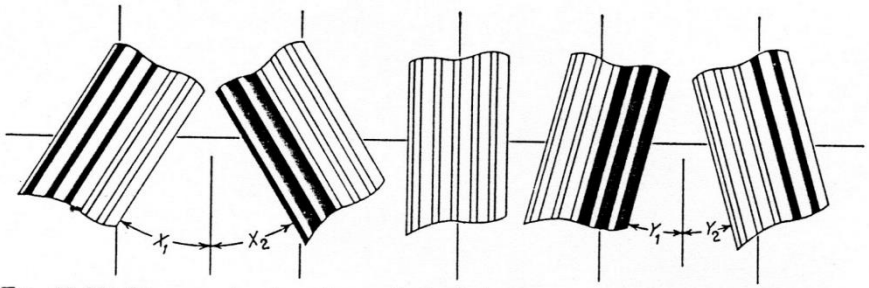


FIG. 13-29. Diagram showing the method of determining the two sets of extinction angles (X and Y) in sections of combined Carlsbad-albite twins cut normal to (010).

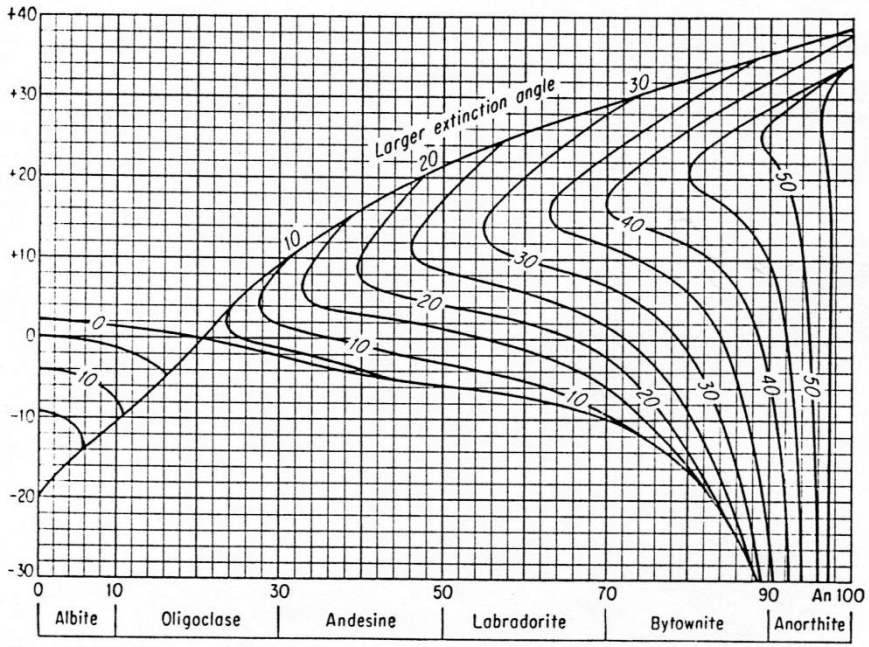


FIG. 13-30. Curves showing extinction angles of combined Carlsbad-albite twins normal to (010) for the plagioclase feldspars. (*After F. E. Wright.*)

Using combined Carlsbad-Albite twins to determine plagioclase composition