Biaxial Optic Figures

Figures from Winter's web notes (2002)

Biaxial Figures

- BxA is the acute angle between the two optic axes
- A BxA figure is one in which the acute angle is perpendicular to the thin section
- If BxA is X, the mineral is negative
- If BxA is Z, the mineral is positive
- Test with a first order plate

Biaxial Crystals

Orthorhombic, Monoclinic, and Triclinic crystals don't have 2 or more identical crystallographic axes

- The indicatrix is a general ellipsoid with three unequal, mutually perpendicular axes
- One axis is the smallest possible n and another is the largest

Fig 10-1 Bloss, Optical Crystallography, MSA

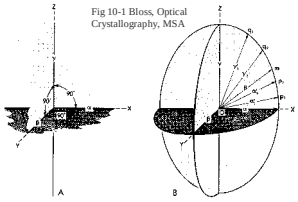


Fig. 9-1. (A) The three, mutually perpendicular, principal vibration axes, X, Y, and Z, and the common symbols for the indices of refraction of a biaxial material for light vibrating parallel to them. (B) Elliptical distribution of the index of refraction (as shown by the vector lengths) for light vibrating parallel to op_x, op_y, oa, oq_y, oq_z within the ZX plane.

α = smallest n (fastest)
β = intermediate n
γ = largest n (slowest)

Principal vibration directions are:
x, y, and z (x || α, y || β, z || γ)

By definition $\alpha < \alpha' < \beta < \gamma' < \gamma$

Biaxial Nomenclature

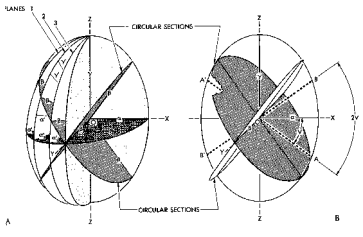


Fig 10-2 Bloss, Optical Crystallography, MSA

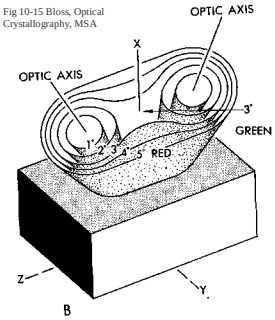
- 2 circular sections ⊥ to 2 optic axes
- Must be in α-γ plane = Optic Axial Plane (OAP)
- Y || β direction ⊥ OAP = optic normal

- Acute angle between OA's = 2V
- Axis that bisects acute angle is acute bisectrix (BxA)
- Axis that bisects obtuse angle is obtuse bisectrix (BxO)

BxA Isochromes

This is the pattern of isochromes for biaxial crystals

Fig 10-15 Bloss, Optical Crystallography, MSA

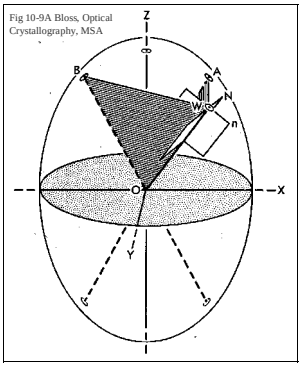


Biot-Fresnel Rule

Useful for determining privileged vibration directions of any light ray from path and optic axes

Vibration directions bisect angle of planes as shown

Fig 10-9A Bloss, Optical Crystallography, MSA



Application of Biot-Fresnel

Draw a conoscopic view of a BxA figure

Privileged vibration directions bisect angles made by lines drawn through the optic axes

Isogyres are locus of all N-S (& E-W) vibration directions

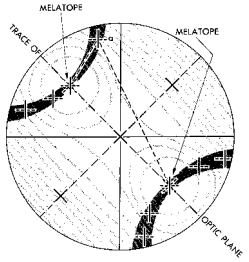
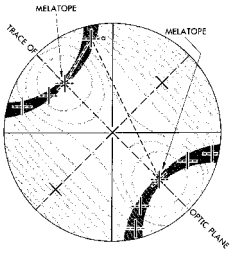


Fig 10-16 Bloss, Optical Crystallography, MSA

Centered, acute bisectrix figure at 45 degrees off extinction position. The two-dimensional analog of the Biot-Fresnel law is applied to point *a* to determine (approximately) the privileged directions for rays emerging there. At several points in the field of view the privileged directions for the rays emerging there are also shown.

Centered BxA Figure OAP45º



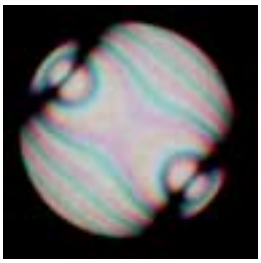
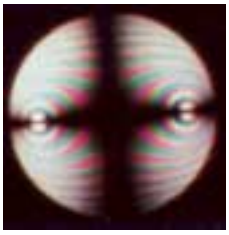


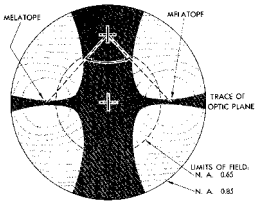
Fig 10-16 Bloss, Optical Crystallography, MSA

Centered BxA Figure OAP E-Wº

Biot-Fresnel construction

Isogyres connected





as seen if the microscope stage is rotated 45 degrees counterclockwise. Extinction occurs in the areas where rays emerge that vibrate parallel to the polarizer. The dashed circle marks the limits of the field of view if an objective of N. A. 0.65 is used instead of one of N. A. 0.85.

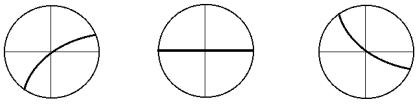
Fig 10-16B Bloss, Optical Crystallography, MSA

Optic Axis Figure

- The optic axis is perpendicular to the thin section
- The grain appears nearly isotropic
- The isogyre will rotate and bend with stage rotation
- Positive case has addition in the BxA direction
- Negative case has subtraction in the BxA direction

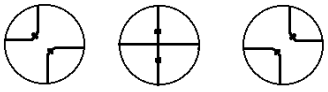
Centered Optic Axis Figure

Rotation with a large 2V



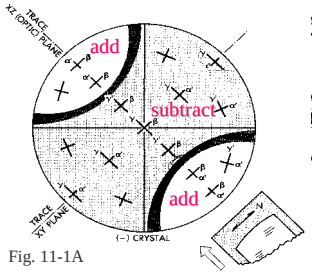
Not much curvature

Rotation with a small 2V:



Biaxial Optic Sign

B(-) α = BxA thus β closer to γ



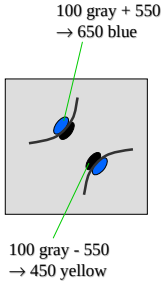
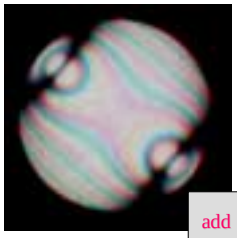


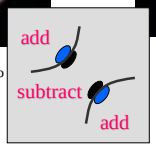
Fig. 11-1A

Biaxial Optic Sign

B(-) α = BxA thus β closer to γ (in stage)



Centered BxA 2V = 35º



Centered BxA 2V = 35º
With accessory plate

Biaxial Optic Sign

B(+) γ = BxA thus β closer to α (in stage)

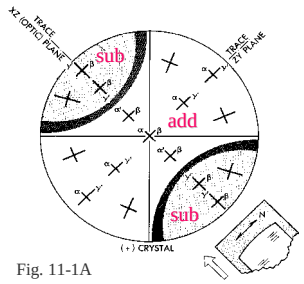
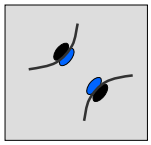
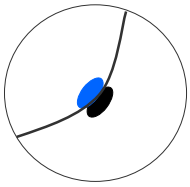


Fig. 11-1A



Optic Sign Determination

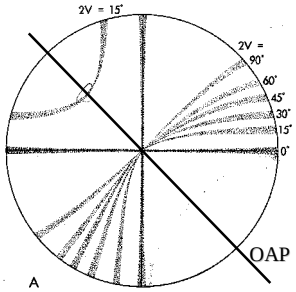


- Optic Axis Figure showing curvature of isogyre
- How to find a crystal for this?
- Blue in NW indicates negative sign

Determination of 2V

- 2V is the angle between the optic axes of a biaxial mineral
- In a BXA figure 2V depends on the separation of the isogyres in the 45° position
- Separation to the edge of view is ~60º
- For an optic axis figure 2V is estimated by curvature of the isogyre

Estimating 2V



(A) Determination of 2V from optic plane is at 45 degrees (NW-SE) to the

Fig 11-5A Bloss, Optical Crystallography, MSA