The determination of the maximum extinction-angle, optic axial angle, and birefringence in twinned crystals of monoclinic pyroxenes in thin section by the Becke method.

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IN nearly every thin section of a rock containing monoclinic pyroxenes it will be found that one or more crystals twinned on the orthopinacoid (100) are included. In such crystals the twin-plane is marked very clearly by the difference of relative retardation and extinction, and also by the interference-bands if the twin-plane is inclined to the plane of section. For the purposes of the complete optical determination, it is essential for the proposed method that one half of the twin should exhibit the emergence of an optic axis suitable for the determination of the optic axial angle by the Becke method.[1] Let the crystal in which the axis is visible be denoted by (1) and the other half of the twin by (2).

The observations to be made on crystal (1) are:

(*a*) The position of the trace of the optic axial plane.

(*b*) The position of the visible optic axis.

(*c*) The extinction-angle relative to (*a*).

These three observations are necessary for the determination of the optic axial angle.

(*d*) The position of the trace of the twin-plane relative to (*a*).

The observations to be made on crystal (2) are:

(*e*) The position of the trace of the optic axial plane, if possible.

(*f*) The position of an optic axis, if possible.

(*g*) The extinction-angle relative to (*a*).

(*h*) The birefringence of the section.

The observations (*g*) and (*h*) are essential.

All the above data must be plotted on a stereographic diagram. It will be obvious that (*e*) should be the same as (*a*), as the twinning is on (100) and the optic axial plane is at right angles to this face. On the stereogram let:

WABE represent the optic axial plane.

AB the optic axial angle as determined for crystal (1).

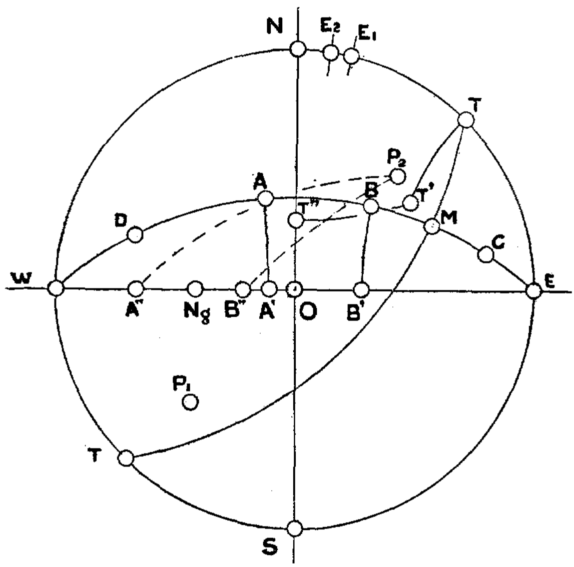
[1] See H. Collingridge, Mineralogical Magazine, 1913, vol. xvi, p. 348.

TT the trace of the twin-plane.

OE_1 the direction of extinction for crystal (1).

OE_2 the direction of extinction for crystal (2).

The next proceeding is to bring the trace of the optic axial plane at right angles to the plane of the diagram by revolving it the requisite amount to bring the optic axes A and B on to the EW diameter at A' and B'. The point T which is on the circumference of the base circle will also move along a small circle to T', and the twin-plane will then be represented by the great circle $NT'S$. The diagram must now be



revolved on the NS diameter the correct angle to bring the point T' on to the NS diameter at T''. This operation brings the twin-plane at right angles both to the plane of the diagram and the plane of the optic axes, and the points A' and B' will move along the EW diameter to A'' and B''.

Let the angle $A''B''$ be bisected at N_g, thus marking the acute bisectrix. The maximum extinction-angle $(c:\gamma)$ is now measured by the angle N_gO, where O is the centre of the base circle.

The revolutions about the NS and EW diameters will have moved the original normal to the section of the crystal (1) to a point P_1. The complementary pole P_2 of crystal (2) will consequently be situated in a similar position in the diagonally opposite sector of the stereogram. The maximum birefringence of the mineral may now be found by dividing the birefringence (h) of crystal (2) by the sines of the angles P_2A'' and P_2B'' according to the approximate formula. As in most cases these angles will be large, the determination will be of a fair degree of accuracy.

Reverting now to the original trace of the optic axial plane $WABE$, we can set off an angle BM equal to the angle $B''O$, the point M thus marking the point where the twin-plane cuts the optic axial plane. On the great circle $WABE$ set off an angle MC equal to MB and on the other side of the twin-plane. The point C will therefore mark the position of an optic axis of crystal (2). Also as the optic axial angle AB has already been determined from observations on crystal (1), the position D of the second optic axis of crystal (2) can be marked off.

A check on the work is furnished by the line of extinction OE_2 of crystal (2) which should bisect the angle COD, according to the Biot-Fresnel law. The accuracy of these determinations would appear to be of about the same order of accuracy as the determination of the optic axial angle.

In the accompanying diagram the angles $2V = AB = 43^\circ$ and $N_gO = c : \gamma = 45^\circ$, and the birefringence $N_g - N_p = 0{\cdot}027$ were determined for a pleochroic augite in dolerite from Craighead, Perthshire.