

THE AMERICAN MINERALOGIST, VOL. 44, JANUARY-FEBRUARY, 1959

POLARIZING ADAPTERS FOR THE WOLFE GONIOMETER

C. W. WOLFE, *Boston University, Boston, Massachusetts.*

The probable usefulness of polarized light, in conjunction with the mechanical framework of a two-circle goniometer has recently occurred to the author when faced with the problem of obtaining the crystallographic orientation of synthetic corundum boules. This note describes the method used to obtain the desired polarization of light and the procedures followed to obtain the optical orientation.

There is an plano-convex lens in the inner end of the collimator (23) and another in the inner end of the telescope (1) of the Wolfe 2-circle goniometer (Wolfe, 1948). These lenses are held in place by screw-on adapters. Discs with diameters equal to that of the lenses were cut from polaroid sheets. These discs were placed between the lenses and the outer noses of the adapters. The plane of polarization of each disc was determined and made to coincide with the vertical or horizontal axis of the adapters when these are screwed on completely. The result is the extinction of light from the light source when the telescope is directly in line with the collimator. Since the polarizing ability of polaroid is not perfect, some light comes through, of course; but the differential is so great that the polarization is completely adequate.

An optional accessory on the Wolfe goniometer is a flat circular tilting plate which is mounted on a central post. This post can be inserted in the central opening of the horizontal circle and locked, if desired, by a long set screw. If the lowest lock screw on the goniometer is released, the horizontal circle is then free to turn, and a one-circle goniometer is effectively obtained. With the long lock screw fastened, the center plate can be turned any amount, and the angles can be read on the horizontal circle. A non-opaque crystal or fragment can be mounted on the tilting table or on a goniometer head which can, in turn, be mounted on the tilting table or on the vertical circle unit. With the crystal unit set between the polarizer and analyzer certain optical properties of the substance can be readily determined. Foremost amongst these would be optical orientation.

It will be of interest to describe the procedure used to obtain the optical orientation of a corundum boule, by use of the above procedure. From a consideration of the uniaxial optical properties of Al_2O_3 , it follows there is but one plane parallel to the axis, L , of the boule which is also parallel to an extinction direction (Fig. 1). This plane must include the c axis, which, it should be pointed out, is not parallel to the axis of elongation, L . If the boule is mounted on the tilting plate in such a way that L

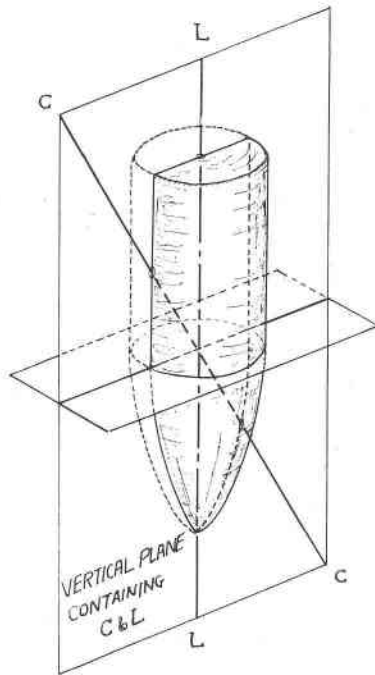


FIG. 1. Extinction positions on boule parallel or perpendicular to axis of elongation L .
This position rigorously defines the L - c plane.

parallels the plane of polarization, and if the boule is observed through the telescope without the ocular, and if the boule be turned about the axis L , extinction will be noted in 2 positions 180° apart. The vertical plane through L and these two positions must then contain the c axis. The same result could be obtained if the boule or crystal were mounted on the vertical circle, in which case L would be horizontal and the plane which contains the c axis would be horizontal. The choice of procedure depends completely on the facility of mechanical operation in the two cases.

In most of the synthetic boules the c axis makes an angle of 52° - 54° with L . If the plane containing the c axis and L has been carefully marked with pencil on the boule, it is a simple matter to turn the boule 90° on the horizontal tilting plate. At this position the boule is light. The boule can be inclined with the c - L plane perpendicular to the light source until extinction is obtained (Fig. 2). In this position the trace of a vertical line on the c - L plane must either be the c axis or a line at right angles thereto. By visual inspection it is possible to recognize whether the vertical line is closer to 54° than to its complement, 36° ; and, thus, the

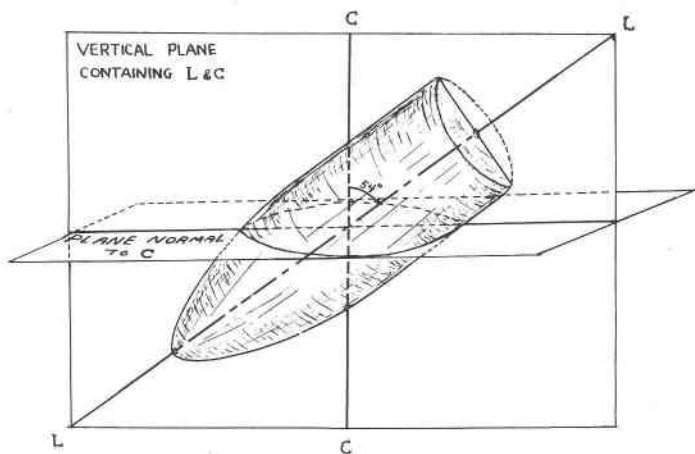


FIG. 2. Extinction positions in c - L plane, locating c .

c axis can be delineated. If the extinction angles to L do not approach 54° - 36° , a thin slice must be cut from one edge of the boule parallel to the c - L plane. The slice can be checked for orientation and the extinction position corresponding to c can be determined with the quartz wedge or by the use of a flash figure. This can be most readily done with the petrographic microscope. Absorption is stronger parallel to c , also.

Any desired orientation of cut relative to the c axis can be made by the development of the proper type of jig. Of interest is the fact that the petrographic microscope can be used to solve boule orientation problems, but it is not so versatile, nor is the light penetration as satisfactory.

The use of the Wolfe 2-circle goniometer in the determination of the index of refraction of high index liquids by the hollow prism method has already been explained (Wolfe, 1949). The extension of applicability of the instrument to optical orientation problems with polarized light and to 1-circle goniometry increases the versatility of the instrument for laboratory purposes.

REFERENCES

- WOLFE, C. W. (1948), *Am. Mineral.*, **33**, 743.
 ——— (1949), *Am. Mineral.*, **34**, 893.