NOTES AND NEWS

DETERMINATION OF THIN SECTION THICKNESS BY THE U-STAGE

J. L. Anderson,
The Johns Hopkins University, Baltimore, Maryland.

Introduction

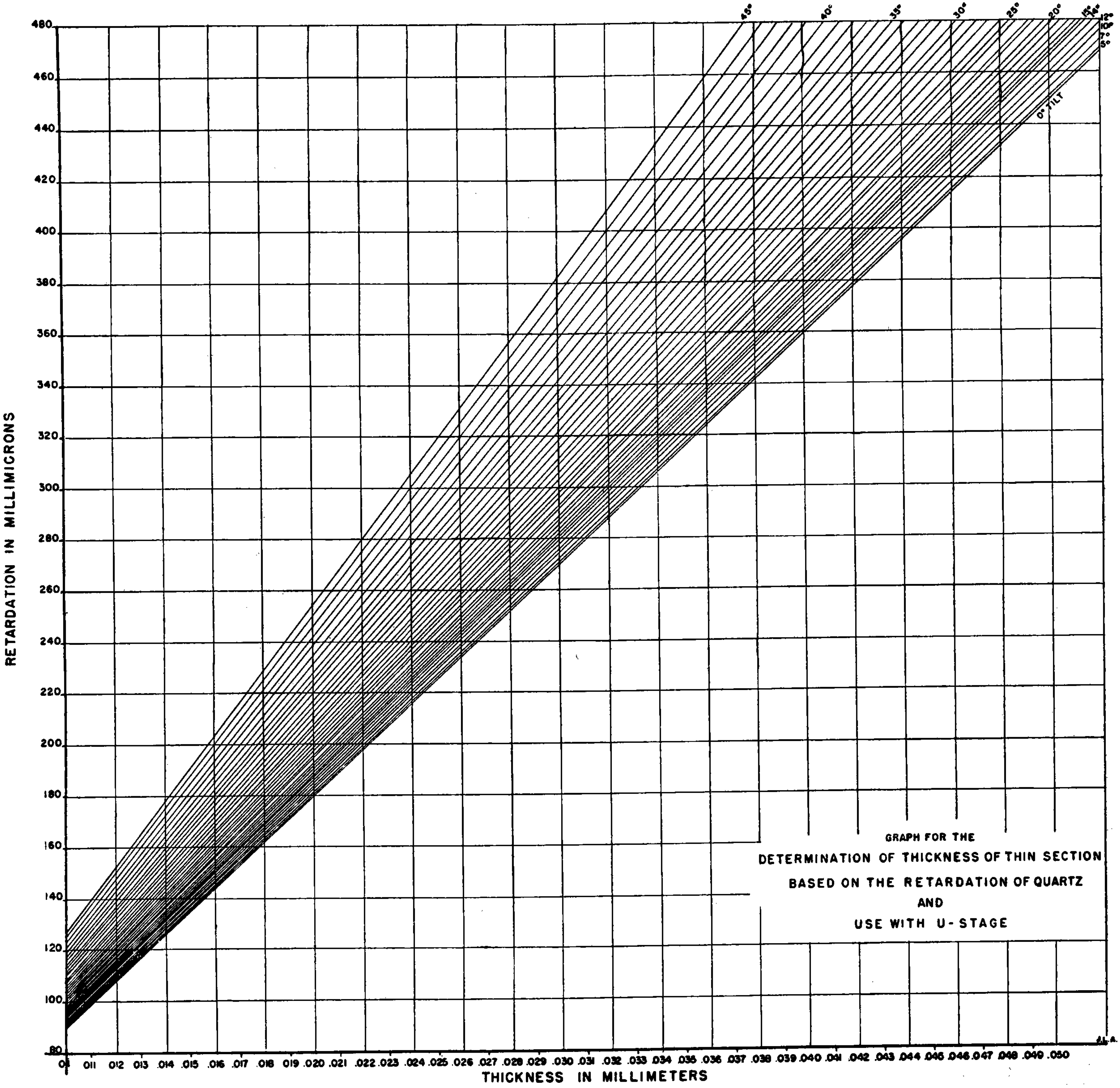
In the determination of the thickness of a thin section, frequent use is made of the calibrated fine adjustment screw on the polarizing microscope, focusing on dust particles on the top and bottom of the section or on inclusions in mineral grains. This method leads to results which are not too accurate because the particles usually are not located in the correct places with reference to the top and bottom of the mineral grains.

The color chart of Michel Lévy which has the slide thickness in millimeters as the ordinate and the birefringence as the abscissa is also used. The assumption which is made when this chart is used is that the maximum birefringence is observed in the mineral in question. In the case of quartz, the maximum birefringence is seen only when the optic axis lies in the horizontal plane. If the slide has a "normal" thickness of 0.03 mm. and the optic axis lies in the horizontal plane, then the maximum interference color, which is straw-yellow, is seen. Emphasis must be placed on thickness when this method is used. A slight variation in thickness, even though the optic axis is horizontal, will cause a departure of the interference colors from straw-yellow. Experience has shown that there is a wide variation in thin section thickness when measurements are made at various places in the slide.

Use of the U-Stage

An accurate measurement of mineral thickness can be obtained through the use of the universal stage. In this connection, quartz, which is almost always present in a slide, is used as a standard of reference. The function of the U-stage is to place the optic axis of quartz in the horizontal plane by the conventional manipulations. In this position, the maximum retardation can be measured by either a Berek compensator or a graduated quartz wedge and an accurate numerical value of the retardation can be obtained. Since the birefringence (n_2-n_1) of quartz is 0.009, the retardation formula $R=t(n_2-n_1)$ can be used to calculate the slide thickness. As an example, if R is determined to be 270 millimicrons when the optic axis is horizontal and (n_2-n_1) is 0.009 then

$$t=\frac{270}{0.009\times 10^6}=0.03 \text{ mm.}$$


45°
40°
35°
30°
25°
20°
15°
14°
12°
10°
7°
5°
0° TILT
RETARDATION IN MILLIMICRONS
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
01
011
012
013
.014
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THICKNESS IN MILLIMETERS
GRAPH FOR THE
DETERMINATION OF THICKNESS OF THIN SECTION
BASED ON THE RETARDATION OF QUARTZ
AND
USE WITH U-STAGE
J.L.A.

Fig. 1.

Since the formula $R=t(n_2-n_1)$ is a straight line curve, a graph can be constructed from which the thickness of quartz for any retardation can be read off.

It is rarely the case that the optic axis of a quartz grain in a slide will lie in a horizontal plane when the axes of the U-stage are at zero. To place the optic axis horizontal involves a tilt on the A_2-axis of the four-axis stage or the N-S axis of the five-axis stage. Knowing the degree of tilt necessary to make the optic axis horizontal and the retardation, measured when the stage is tilted, it is easy to calculate the retardation and thickness for the section in the zero position. For example, if the stage were tilted 30 degrees and at this position the retardation were measured as 312 millimicrons, then the retardation at the zero position would be $312\times$cosine $30°$ or 270 millimicrons. From this, the normal slide thickness of 0.03 mm. can be either calculated or read from the graph.

In order to overcome the need of making calculations after each measurement, a graph (Fig. 1) containing curves for various angular tilts of the U-stage when the quartz optic axis is horizontal has been prepared. In using the graphs the retardation of a quartz grain is measured and the value located along the ordinate of the graph. In order to find the mineral thickness when the slide is at zero tilt, the retardation value is traced horizontally until it intersects the proper curve representing the U-stage tilt. From this intersection a vertical line is projected downward to the horizontal axis where the correct thickness is read off. Using the above retardation as an example, the value 312 is traced across until it intersects the 30 degree curve. This point is traced downward to the H-axis where the value of 0.030 mm. is read off. This means that when a slide of 0.03 mm. thickness is tilted 30 degrees it produces a retardation of 312 millimicrons. If it is desired to know the retardation in the zero position equivalent to the retardation of 312 millimicrons at 30 degrees, then from the intersection of the 312 line with the 30 degree curve, a normal is dropped to the curve representing the zero tilt. From this point a horizontal line will intersect the ordinate at 270 millimicrons. The curves, therefore, will indicate not only the thickness for zero tilt, but also the retardation equivalent to this thickness.

CONCLUSIONS

Experience has shown that thin sections are not of uniform thickness. Three recent measurements on a slide of a metamorphic rock gave values of 0.036 mm. in the center of the section, 0.024 mm. halfway to the edge, and 0.018 mm. at the edge. The assumption that a slide is 0.03 mm. is not valid and the figure should not be used if calculations involving thickness are employed.

The method described above can be used for the determination of the alpha index of micas belonging to the biotite group. The gamma index is determined by oil immersion and the retardation is measured when the cleavage has been made vertical. The slide thickness is ascertained by measurements on a nearby quartz grain. Using the retardation formula, the birefringence ($n_2 - n_1$) is calculated from:

$$(n_2 - n_1) = \frac{R}{t \times 10^6}.$$

The value of n_2 is the gamma index; therefore, the alpha index is gamma minus the value of the birefringence determined above. The gamma and alpha values can be used with the four component diagram of Winchell (*Am. Mineral.*, **20,** p. 776) to ascertain the theoretical composition of the biotite mica.

NOTES ON THE NOMENCLATURE OF TEXTURAL TERMS IN PETROGRAPHY

L. Dolar-Mantuani,
University of British Columbia, Vancouver, B. C.

The usage of the terms "texture" and "structure" in continental Europe is markedly different from that employed by most North American and British authors. In many instances the European uses the term "texture" where "structure" would be used in this country, and vice versa. Furthermore, differences are noted in the modifying adjectives used in describing the texture of rocks.

Johannsen, in one of the most helpful text-books on the texture and structure of rocks, defines texture as follows: "Texture is used for the smaller features of the rock itself, that is, those features which depend upon the size and shape, and arrangement and distribution, of the component minerals." (Johannsen, A.: A Descriptive Petrography of the Igneous Rocks; Vol. I, 2nd. Ed., p. 32.) This textbook includes in a handy Appendix, definitions of 376 textural and structural terms, together with references to the first recorded use of each term.

While comparing the textural and structural terms used by Johannsen and other authors, the writer felt that they could be divided into two main groups. The first group, taken mainly from Latin and Greek words, including terms such as, *intersertal*, *porphyritic*, *fine-grained*, refer to only one property or characteristic of the mineral or rock. The term of the second group, such as *aplitic*, *granitic*, *diabasic*, are derived from rock