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MICROHARDNESS OF THE PLAGIOCLASE SERIES

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Application of indentation microhardness technique to mineralogical problems is a comparatively recent undertaking. The few published works (1, 2, 3) naturally aim at supplying only numerical data on microhardness of various minerals.

During routine laboratory work in the postgraduate mineragraphy classes it was observed that the high reproducibility of results and sensitivity of Leitz "Durimet" microhardness tester—when worked under standard conditions—might be profitably utilised in studying the members of a solid solution series.

Details regarding the instrument, working principle, and experimental procedure can be had from the booklet accompanying the instrument and also from Nakhla's paper. Discussions on these are therefore purposely omitted from the text.

Six plagioclase crystals, ranging in composition between An_5–An_{85} were crushed to 25 mesh, mounted separately on bakelite moulds and polished. Microhardness of twenty random grains were taken, each with working loads of 15, 25, 50, 100, 200, 300, 400 and 500 gms. (Table 1). Highest hardness values with reference to each load was taken to represent the maximum *Vicker's microhardness* of the mineral for that particular load. The feldspars were identified by determining N_x and N_z by the liquid immersion method.

Figure 1 shows variation in microhardness with compositional variation at different loads.

However it must be emphasized that this preliminary investigation does not claim to have provided a very accurate curve for plagioclase determination on the basis of microhardness. That would require some

TABLE I. H_V (Kg/mm².)

Specimen & locality	An cont.	15 gms.	25 gms.	50 gms.	100 gms.	200 gms.	300 gms.	500 gms.
Albite (Norway)	5%	1374	1492	1261	1682	2576	*	*
Oligoclase (Tvedestrand, Norway)	25%	944.5	1064	926.7	1137	1138	885.3	685.5
Andesine, Esterel, France	40%	903	1064	1248	1282	975	913	917
Labradorite, Sucmi, Finland	52%	936	1221.5	1060	1244	1066	958	886
Bytownite, Bengal	75%	420	590	480	560	500	440	400
Bytownorthite, Grass Valley, Calif.	85%	102	119.5	134.7	150	140**	131**	120**

* Highly cracked, no accurate measurement possible.

** Cracks developed from the edges of indentation outwards.

more hardness data of well analysed samples representing the whole range. The primary significance of the result lies in the fact that the trend of variation in hardness remarkably matches with the structural and compositional variation trends in the plagioclase feldspars. The hardness appears to be a linear function of Ab content (Fig. 1) with a sharp break in region An_{30}–An_{70} which, it may be recalled, is the region of immiscibility and consists of alternate Ab and An structural sheets. The two ends of the curve, i.e. the albite-oligoclase and bytownite-anorthite regions are, again, domains of pure albite and pure anorthite structures respectively. The coincidence is too remarkable to be fortuitous.

It may also be tentatively suggested that, at any point, the degree of deviation from rectilinearity might be a measure of (1) degree of ex-solution or (2) degree of departure from original structure.

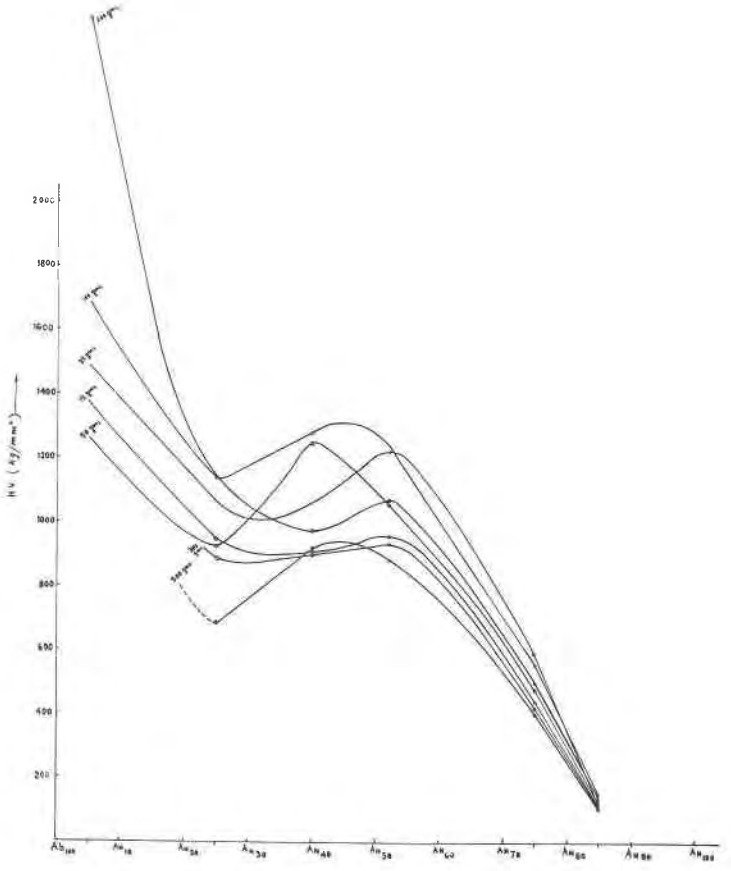

FIG. 1. Variation in microhardness with composition at different loads.

The results thus strongly indicate that microhardness studies of solid solution series might be utilised in detecting structural breaks and compositional variation.

Limitation

The obvious limitation of this technique is that although 20 random grains were examined in each case, the highest value obtained might not represent the maximum hardness. However in all cases the ranges of hardness of each species are so widely apart, compared to the range of hardness variation of a mineral with varying orientation, that this limitation does not seem to affect the general observations and conclusions.

References

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LATTICE CONSTANTS AND PROBABLE SPACE GROUP OF ANHYDROUS CUPRIC SULFATE (ARTIFICIAL CHALCOCYANITE)*

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Anhydrous cupric sulfate was prepared by heating Baker and Adamson Reagent Grade $CuSO_4 \cdot 5H_2O$ to approximately 300° C. for two hours. The *x*-ray powder diffraction pattern at 25° C. was obtained in a Norelco high angle recording diffractometer, using CuK_α radiation ($\lambda = 1.5418$ Å) and a Ni filter. The scanning speed was $\frac{1}{8}°$ (2θ) per minute.

The indexing was done by means of the similarity to the zinc sulfate pattern (Schiff, 1934) and by using the goniometric value for the axial ratios of natural chalcocyanite, which is orthorhombic dipyramidal (Dana's system, 1951). All the observed diffraction peaks could be satisfactorily assigned as being due to an orthorhombic lattice with the following unit-cell dimensions, obtained by a least-squares treatment: $a_0 = 8.391 \pm .013$ Å, $b_0 = 6.811 \pm .010$ Å, $c_0 = 4.791 \pm .008$ Å.

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