Ms. rec. September 28. 1944.

HIGH TEMPERATURE OPTICS IN PLAGIOCLASES OF THE OSLO REGION

BY

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With 1 figure in the text.

The exact knowledge of the variation of the optical orientation with the chemical composition in the plagioclase series, is principally due to the work of Becke. He used the conoscope for his determinations, but later the universal stage gradually came into use, and the methods for this are given by L. Duparc and M. Reinhard (1924, in French) and by M. Reinhard (1931, in German). The stereograms with the migration curves were suited for most of the plagioclases, but in some cases the literature shows that there were obvious discrepancies. The probable reasons for this may be ascribed to various causes: The potash content, wrong migration curves, unexact orientation of the twins, errors of measurement, etc. A. Köhler (1942a) is the first who realized that most of the abnormal feldspars were derived from volcanic rocks; indeed all plagioclases from such rocks deviate from the migration curves of the previous authors. Köhler speaks of the existence of a "Hoch- und Tieftemperaturoptik". To show the properties of this new high temperature series, Köhler has worked out a new diagram type for the migration curves. The values of the angles $\alpha_1\alpha_2, \gamma_1\gamma_2$ and of the angles between the different optical axes for the common twins are given as a function of the An content. The curves of these "Köhler values" are given for the whole low temperature series and the interval 30—60 An of the high temperature series.

The true existence of such a series is proved by H. Scholler (1942), who transformed low temperature plagioclases into the high temperature type by exposing them to heat. The results of former investigations of similar kind are now easy to understand. T. F. W. Barth (1931) succeeded in transforming low temperature plagioclases into the high temperature type, but C. T. Barber (1936) who treated high temperature feldspars, did not find any noticeable change.

Table 1.

No.	Rock	Angles		High temp. values	Low temp. values	Mean of high temp. values	Powder determ.	Zone method
1	Rhomb porph. $RP_{13\,d}$ Sørkedal	$\alpha\ \alpha^{-\pi}$	7	43	40	42	42	54
		$\gamma\ \gamma^{-\pi}$	115	40	36			
		$A\ A^{-\pi}$	70	44	47			
2	— » —	$\alpha\ \alpha^{-\pi}$	10	45	42	44		50
		$\gamma\ \gamma^{-\pi}$	117	51	51			
		$A\ A^{-\pi}$	68	45	49			
3	Rhomb porph. $RP_{13\,b}$ Sørkedal	$\alpha_1\ \alpha'_2$	94	48	45	45	42	50
		$\gamma_1\ \gamma'_2$	28	42	58			
		$B_1\ B'_2$	54	46	48			
4	Akerite porph. N of Burudvatn, Bærum.	$\alpha_1\ \alpha_2$	78	45	43	49	—	63
		$\gamma_1\ \gamma_2$	124	51	61			
		$A_1\ A_2$	67	51	56			

Four stereograms with their "angle values" of Köhler and the corresponding An values in the high and low temperature series. Nos. 1 and 2 are measurements on different parts of a large crystal.

H. Tertsch (1942) has made measurements on basic synthetic plagioclases and has thereby enlarged the interval of known high temperature values to 30—100 An. A paper on the missing "acid" interval was announced.

For a paper on the petrology of some volcanic rocks in the Oslo region, I wanted to determine the plagioclase phenocrysts in akerite porphyries and rhomb porphyries. Stereograms of akerite feldspars were prepared by me. Most of them did not correspond very well to the migration curves of Duparc and Reinhard, although a few did. Some of them showed a good accordance for the one twin, but not for the other. It was believed that inaccurate measurements were the chief source of the differences, and to save time the zone method of Ebert (1931) was used for the succeeding determinations.

Then some rhomb porphyry phenocrysts, which were large enough and sufficiently unaltered, were determined by immersion liquids, and the determinations showed 7—9 An less than the zone method determinations! By seeking the reason for this, Köhler's paper was

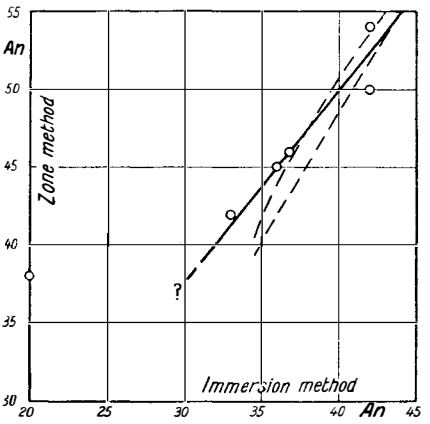

Fig. 1.

The An values of some rhomb porpyhry phenocrysts, found by the immersion method, with the corresponding values from the zone methed. The curve should thus give the correspondence between the new correct An values, and the values which are derived in the usual manner: Extinction angles ⊥ (001) and (010) or ⊥ (010). The two broken curves give the same correspondence; they are derived from curves of the extinction angles of Köhler and of Tertsch.

discovered. A reexamination of the stereograms was made, and some new ones were prepared. The angles then available were compared with the curves of Tertsch (1942, p. 206—211) for the two series. Since every angle correponds to two An contents (one for each of the two series), each diagram gives two sets of values, one set corresponding to the high temperature optic, the other set to the low temperature optic. The individual readings of the high temperature set give the most consistent values, but it must be admitted that the consistency is in no way as good as in the examples stated by Köhler (1942b). Table 1 gives the angles from four diagrams, and their interpretation. The variations within the individual high temperature values do not surpass 6 An, while the low temperature values exhibit much greater variations. Feldspar No. 4 of Table 1 demonstrates that the basic plagioclases get a considerable reduction in their An values by using the high temperature curves; thus 63 An in the phenocrysts of an akerite porphyry (determined on several crystals) is a sensational value, but reduced to 49 An, it becomes a common one.

There are reasons to believe, therefore, that the feldspars listed in Table 1 exhibit the "Hochtemperaturoptik" and not the "usual" plagioclase optics.

This may be checked on specimens which can be determined with the immersion method. This seems not to have been tried by the Austrian authors. Some rhomb porphyry feldspars were sufficiently unaltered to be determined by this method, and the results are plotted against the zone method values. See Fig. 1.

For comparison corresponding curves may be taken out of the diagrams of Köhler and Tertsch for the extinction angles ⊥ (001) and

(010) in the two series. The maximum extinction angles in the zone [010] coincide with the extinction angles ⊥ (001) and (010) up to 55 An, and the last mentioned extinction angles may therefore be compared with values derived from the zone method. The difference in the trend of the broken curves in the figure is caused by the fact that there is some difference in the curves for the extinction angles ⊥ (001) and (010) for low temperature plagioclase in the tables of Köhler, compared with those of Tertsch.

It is to be expected that the phenocrysts of the rhomb porphyry lavas belong to the high temperature series; more interesting is the fact that the insets of an intrusive rock with lava texture (= akerite porphyry) also do so. It is possible, however, that they belong to a modified high temperature series; in this case there is a transitional change in the optics of the high and low temperature modifications; the two feldspars thus having the relation of polytropy, (Barth 1934, p. 283).

Acknowledgement.

The investigation was carried out at the Mineralogical Institute of the University, and I am greatly indebted to the director, professor Tom. F. W. Barth, for kind interest during the work.

Sept. 26th, 1944. Mineralogisk Institutt, Oslo.

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Printed February 26th, 1945.